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TIMBER SEASONING.

It is a long time since there has been any article in the *Indian Forester* on the subject of timber seasoning (1925 February and May) but during this time research work has been carried on, following the lines predicted in the February article and with very satisfactory results in most cases.

Attention has been concentrated on the jungle hard-woods, which are notorious for their propensity to split and crack and generally misbehave during ordinary air seasoning, and as a result of the experiments many of these have been turned out as good, useable and economical timbers when artificially seasoned in a proper manner.

Some dozen or more different species have been kiln-seasoned with complete success and the seasoned wood manufactured and put into use as railway carriages, rifle stocks, gun carriage wheels, furniture, tea boxes, panelling for the Council Chamber, New Delhi, etc.

Experiments with as many other varieties have been started and success will ultimately be attained in most cases.

In the case of ordinary air-seasoning the sawn timber is stacked in such a manner that air can circulate around and between the boards and for drying effect the natural forces of sun-heat, wind and air humidity have to be relied on. Unfortunately these are not under control and are very variable. The only possible control is negative, you can protect the timber from direct sun-heat and to some extent from hot dry wind ; but taking

conditions as they are the climate of India is not ideal for timber seasoning and refractory timbers on the one hand, will deteriorate through splitting and distortion in the hot weather, whilst other kinds discolour and rot during the rains period.

With artificial or kiln-seasoning you can select the best seasoning conditions for each type of timber and maintain these independently of outside climatic variations and as a result not only is the wood rapidly brought to the required state for manufacture, but it suffers very little degrade or damage during the process.

Timber drying kilns cost a good deal to instal and require careful operation and supervision. It is not economical to work on a small scale and, therefore, the use is limited to timber using Government departments, who can prevent the monopoly and increase in price of any special timber, by introducing the use of several substitutes; and possibly to timber merchants who own standing timber that is at present only used as fire wood but which would be marketable at a good price, if seasoned.

A sawmill, run by the Forestry department, Madras Government, is working night and day and selling kiln dried box shooks of various kinds of wood that previously had no timber value, and gradually other hard-woods are being introduced into railway carriage construction to prove that teak, however desirable it may be, is not indispensable.

In this connection we have read with much interest Burma Forest bulletin No. 16, by F. Pemberton, Forest Engineer, Rangoon, which records tests on reasonably large samples of a number of Burmese timbers during both air-seasoning and kiln-seasoning processes.

The most interesting part of the report is that which shows the results in the form of curves, which illustrate that wood, after having reached a reasonable state of dryness either by air-seasoning or kiln-seasoning, will re-absorb moisture during the rains and lose it again during the following dry season. After the first year there is little difference in fluctuation between air-seasoned and kiln-seasoned timber, such difference being in favour of kiln-seasoned material which entered the experiment

with much lower moisture content than the material that was only air-seasoned.

Moisture content figures are useful to the timber user, but Mr. Pemberton produces more practical results, namely the actual shrinkage figures with various species from the green state down to various moisture contents. For instance a plank of "laurel" (*Terminalia tomentosa*) when freshly sawn, at 38 per cent. moisture, was 8·11 inches wide. At 14 per cent moisture it had shrunk to 7·97″ and at 8 per cent to 7·83″ wide.

A table of comparison is also given which shows that some timbers will only shrink one-half or one-third of this amount for equal moisture variation and that others will shrink to a somewhat greater degree. Taken conjointly with the moisture content variation curves and the shrinkage figures, it is seen that liberties can be taken with certain timbers but that with others allowance must be made for contraction. Referring to the example quoted above, a table top of laurel, seasoned to 14 per cent. which might suffice for a moist climate, if transported to Delhi (where moisture equilibrium is generally 6 to 8 per cent.) would shrink ¾″ on a 3′ 6″ width, and if held rigidly by cross battens would split badly.

This all emphasises the importance of complete seasoning before use. Kiln seasoning is most sure but if air seasoning is done this must be completed in the dry season and at the place where the timber is to be used.

Timber users will not be bothered with all these refinements, but Research Institutes can tell them the most suitable moisture content for their particular district and warn them as to the amount of shrinkage to expect with various species.

THE CAPTURING OF WILD ELEPHANTS IN BURMA,

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Burma is one of the few countries in the world in which wild elephants are found in large numbers. In former days under

Burmese Rule, large herds abounded throughout the Province the animals being particulraly plentiful on the Yomah Ranges, on the hills of the Shan States and all along the Siamese frontier. At that time the Karens used to capture wild elephants with the help of *koonkies* or well trained tame decoy elephants, the method of procedure being as follows :—

The *koonkies* approached the wild elephants in the jungle with the catchers suspended below their necks. On drawing sufficiently close to an animal the catchers lassoed its legs or neck with a strong rope one end of which they made fast to a tree. Then, with the assistance of the *koonkies* the captured animal was taken away to a place where it could be thoroughly tamed, such a place being known to the Karens as *Thaw-ka-me*. This method of capture was naturally a most dangerous one and serious injuries both to men and elephants were frequent. Also, only young animals could be captured in that way, an elephant over six feet in height being seldom caught. The method, which is generally known as "mela shikar" is nowadays only employed to a very small extent in the Upper Chindwin and Myitkyina Forest divisions, it having been superseded long ago throughout the rest of Burma by the more profitable Karen Kheddah method.

Besides "mela shikar" a method of catching wild elephants by means of pitfalls was often resorted to. This method was a particularly cruel and wasteful one, in that the animals captured frequently suffered broken limbs and other serious injuries. The method has long since been prohibited by law.

In the year 1879 the Elephants Preservation Act was introduced which made it unlawful for anyone to kill or capture wild elephants except under the terms of special licenses issued by Government. Licenses to kill elephants and also annual licenses to capture them were issued by the Deputy Commissioners of districts acting in consultation with the Divisional Forest Officers. Licenses covering longer periods were issued direct by the Local Government. There was no standard form of kheddah license and the conditions varied at times according to the particular ideas of the issuing authorities. Now, however,

the rules have been revised and in future there is to be one standard form of license which will be issued by one central authority. This should have the beneficial effect of simplifying the control of all licensees' work and of ensuring that the best men are encouraged whilst the inefficient and bad workers are kept out. When these new rules come into force at the end of this year it will be necessary for anyone desirous of obtaining a kheddah license to apply to the Game Warden, C/o the Chief Conservator of Forests. The Game Warden will maintain registers and records concerning the work of all licensees and will do his best to assist the good workers and eject the bad.

At the present time, wild elephants are still very plentiful in many parts of Burma and in certain districts they do a great deal of damage annually to cultivation, plantations, and sometimes even to human habitations. They have recently been reported as being particularly destructive in the following forest divisions :—

Mongmit, Mogok, Katha, Kaukkwe, Bhamo, Myitkyina and Mansi.

Maymyo.

Shwebo, Mu, Lower Chindwin and Myittha.

South Pegu.

Allanmyo and Insein.

Thayetmyo, Bassein, Henzada and North Arakan.

It is advisable, of course, in the interest of the general public that kheddah operations should be carried out in the areas mentioned above before other divisions in which the animals do practically no damage are touched.

The method of capture generally adopted in Burma to-day is known as the Karen method which will now be described in detail.

The general idea is that the elephants are driven into a long-narrow stockade by men, then hauled out by men with ropes and put into small training cages each of which just holds one animal. A few tame elephants may or may not be used.

The best time of year for carrying out operations is during cold weather because in the rains and hot season both men and elephants are seriously affected by the adverse climatic conditions

and heavy losses are likely to be incurred. In the past there has been abundant evidence to prove that large numbers of captures have died on account of the catch having been made too late in the season. With the exception of the dry zone where the conditions are quite different to those prevailing throughout the rest of Burma, the months of December, January and February are admittedly the best for catching elephants, and of these January and the beginning of February is probably the best time of all. The climate is then cool and dry, shade, fodder and water usually plentiful, and the animals have much greater power of recovery from the initial shock and strain of capture and from the sores a certain number of which are inevitable. Almost every licensee will admit these facts and yet drives are often made in March, April and even as late as May and June.

It has often happened in the past that a man has not received his license, entitling him to start operations, until late in the season, and more often still that a licensee has had difficulty in collecting his labour force in time to allow of his commencing work at the beginning of the cold weather. Then again driving may have been started early enough but for some reason or other it may have failed to produce any captures and so the licensee in order to avoid great financial loss has continued driving until late into the hot weather or early rains in the hopes of bringing off a catch to cover the expenses incurred by his earlier efforts. Finally, elephants in most places are easier to drive in the hot weather when the leaves are down and water and fodder scarce and this is sufficient to tempt the unscrupulous licensee to make his catch then and to take the chance of making a small profit should a few of his animals survive.

When the elephants are caught in the hot weather, there is generally a scarcity of good shade, fodder and water, and they do not seem able to resist the effects of the shock of capture and sores produced by their struggles in the stockade and by the chafing of the ropes. When caught during the rains the results are much the same but then the presence of mud makes the healing of the inevitable sores still more difficult.

In the dry zone, the conditions are reversed and there June to December is the best time for driving since during that period only is there sufficient shade, fodder and water.

A licensee, having obtained the necessary license for a certain tract of forest, should first of all explore the area thoroughly and decide upon the most suitable place for the construction of the actual stockade. The place chosen must be cool and shady. Trees of different sizes, to provide timber for the stockade, must be available in sufficient numbers close at hand. The presence of good and abundant water and fodder is essential and above all things, of course, the site chosen must be one which is habitually frequented by wild elephants.

As soon as the site for the stockade has been decided upon the kheddah manager must choose a suitable and convenient camping ground for his employees upon which they can erect the requisite huts and sheds. The camp should be about 1—2 miles distant from and in rear of the stockade or else at about the same distance to one side of it. A good watersupply is essential and low-lying, damp situations should, at all costs, be avoided for the erection of the operators' quarters.

When the men have settled down in their camp they should commence to collect and prepare all the necessary materials. A licensee who wishes to capture, say 20 elephants must maintain a labour force of at least 60 men because each capture should be tended by three men if it is to be properly trained and cared for. The operators should be divided up into groups, each group being allotted a separate task.

The first things to be done are—

(*i*) to locate and fell trees of different sizes for posts. Only trees of "unreserved" species may be used for this purpose;

(*ii*) to collect canes and creepers required for binding;

(*iii*) to collect *shaw* fibre for the manufacture of ropes;

(*iv*) to make the ropes of the different sizes required.

The kheddah manager must also see to the collection of all other necessary instruments and tools such as guns, *daks*, spades, axes, saws, chisels, gimlets, spears, hooks, lamps, crackers

fetters, torches and whistles. When all these articles have been collected they must be placed in readiness for immediate use each in its proper place.

Having completed all the preliminary arrangements tabulated above the exact dimensions and shape of the stockade should be marked out by the manager and the men can then get started upon its actual construction.

Whenever possible the actual kheddah site should be so chosen that strong living trees can be utilized as gateposts, and for strengthening the end and sides of the stockade.

The general plan of a Karen kheddah is usually as shown in the accompanying sketch (Fig. 1).

The width is usually about 6 to 9 feet at the end AC and 12 to 18 feet at the mouth BD. The end must be very strongly constructed.

BE and DF are the projecting wings of the stockade and their lengths vary with the nature of the ground and type of forest in each case.

EGF is the outer fire-line. It is merely a path cleared in a semi-circle round the mouth of the kheddah along which lamps are placed during a drive.

EHF is the inner fire-line. It is exactly similar to the outer line.

Along the whole length of both these fire-lines lamps are placed on sticks or posts erected at intervals of 12 to 15 feet.

* * * * These marks denote observation posts called "*Haws*" by the Karens. They generally take the form of small *machans* or platforms built high up in trees in each of which two or three men wait and watch the movements of the wild elephants. The watchers should be provided with torches, fire-crackers, *dahs* and hollow bamboos (*kaladet*) for making a noise.

The Construction of the Kheddah. (*See Fig. 2.*)

The sides of the kheddah consist mainly of small "wall" posts, 1½ to 2 feet in girth and 16 to 18 feet long sunk from 3 to 4 feet into the ground at intervals of 6 to 7 inches. On the outside of these vertical posts and securely lashed to them are placed horizontal "securing" posts about 2 to 2½ feet apart

FIG. 1. PLAN OF A KHEDDAH.

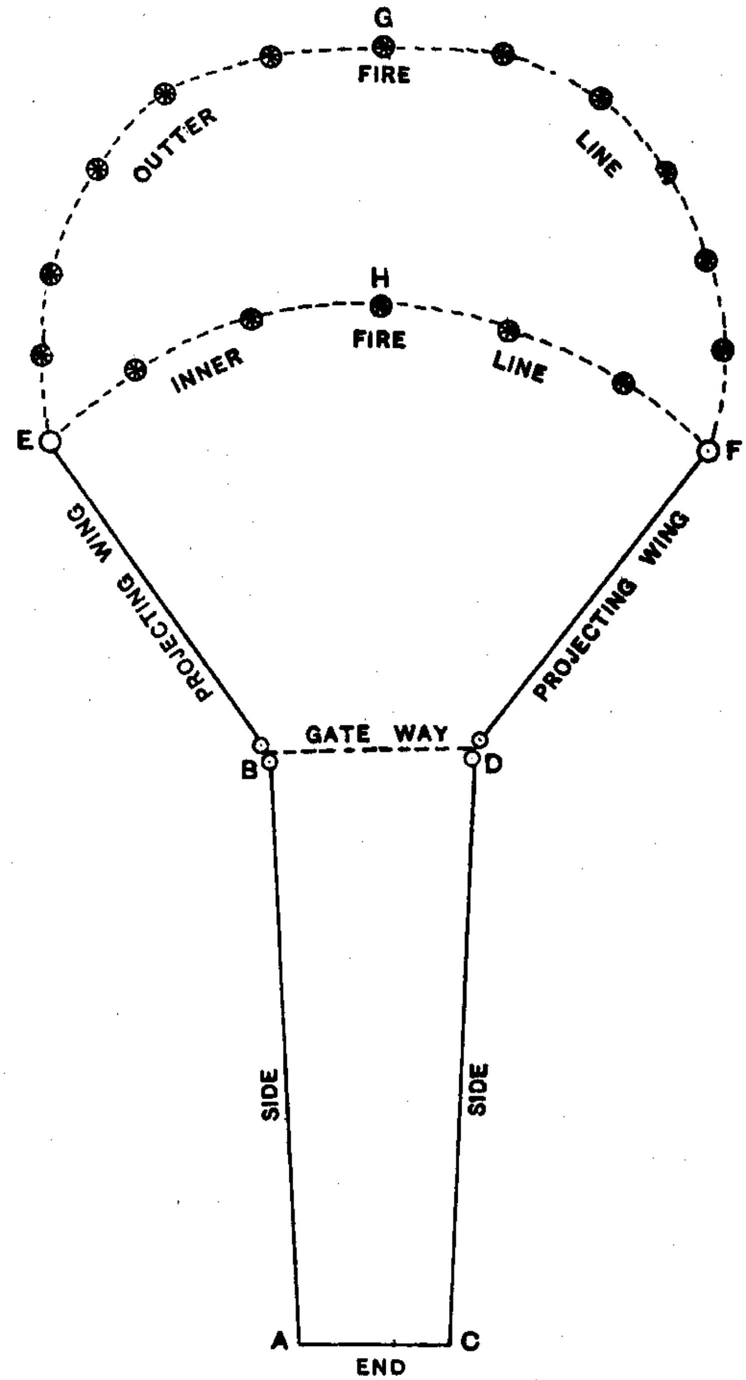
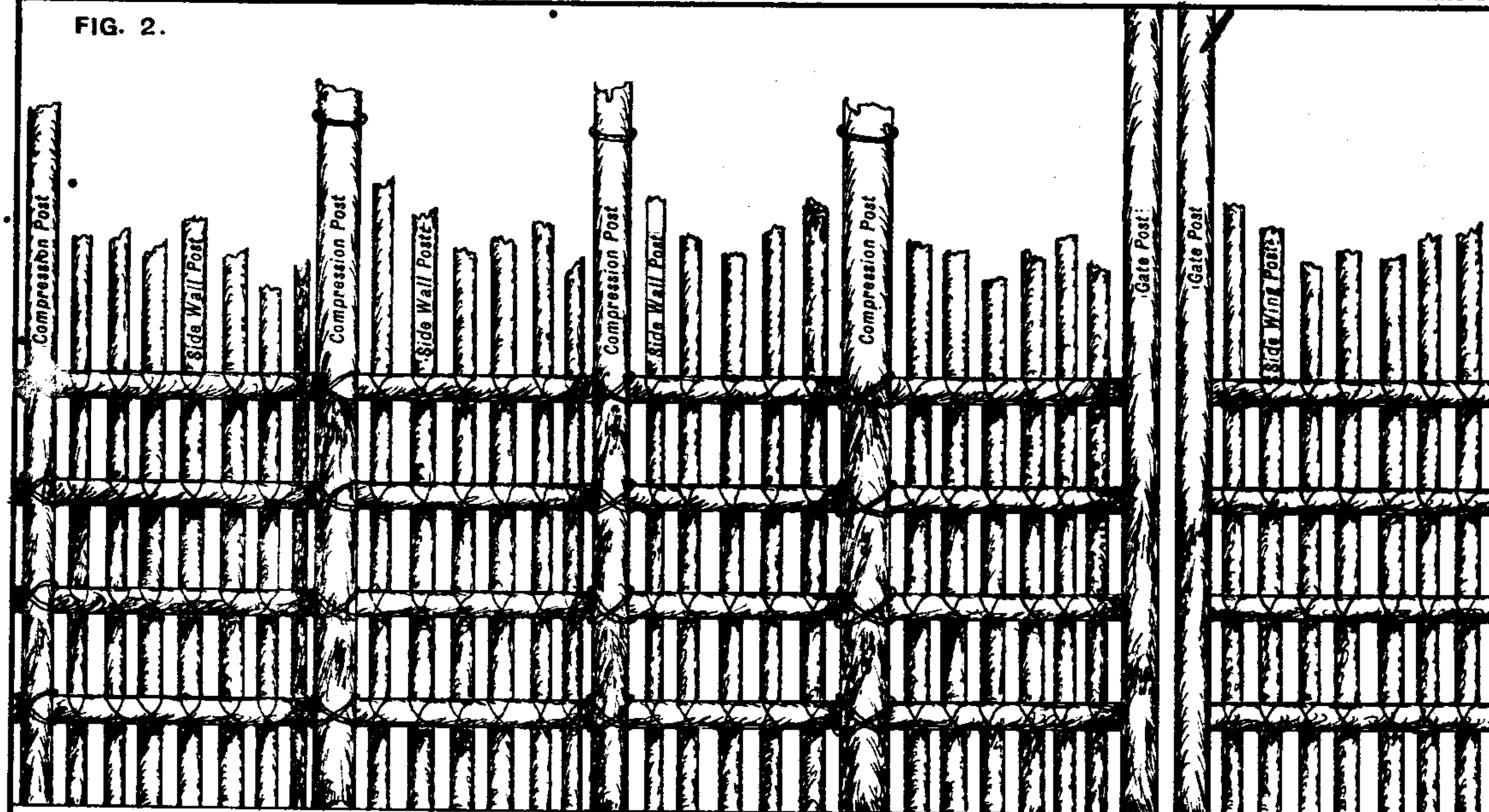


Photo. Zinco. November, 1927.—No. 571

Plate 2.

FIG. 2.



SIDE OF THE MAIN STOCKADE.

PROJECTING WING

Photo. Zinco., November, 1927.—No. 571-1

FIG. 3 TAMING AN ELEPHANT IN A TRAP KHEDDHA.

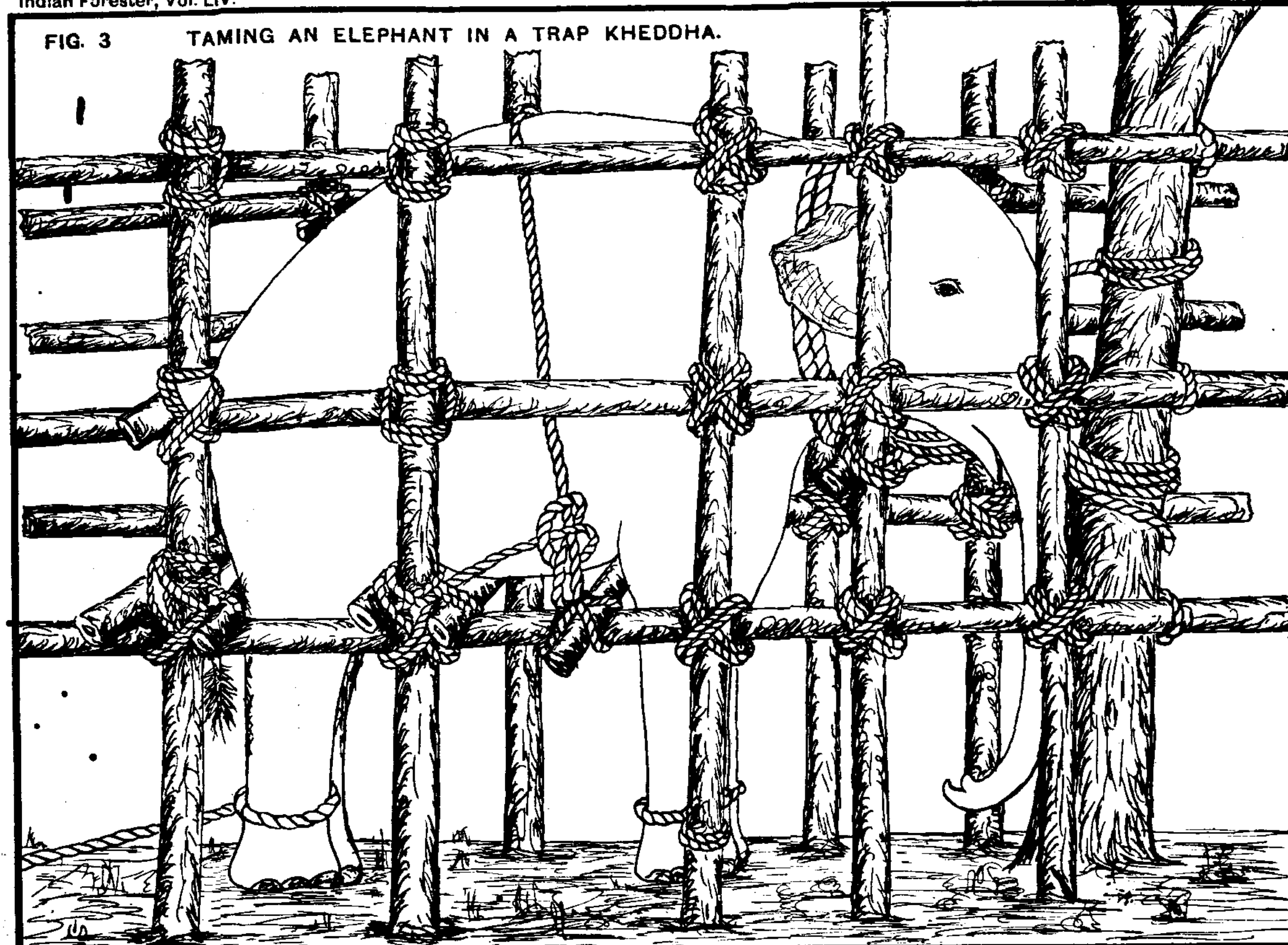


Photo. Zinco. November, 1927.—No. 571-2

Then on the outside again are erected stronger and bigger "compression" posts about 20 to 25 feet in height sunk at least 4 feet into the ground at intervals of 6 to 7 feet and in pairs, one on each side of the stockade. The securing wall and compression posts are all firmly lashed to one another with canes, creepers or cord. The tops of each pair of compression posts are forced towards each other by twisted canes or creepers being passed round them and securely tied, the pressure thus exerted tending to hold the whole body of the kheddah together. The walls of the stockade are further strengthened by supporting struts which are placed against them at an angle of about 45 degrees.

The end of the kheddah if not actually built against a strong living tree must be greatly strengthened by many supporting struts so as to enable it to withstand the onward rush of the captured elephants.

The gate, which is a portcullis, requires most careful construction and must, of course, be very strong. The four gate posts should be 40 to 50 feet in height and sunk at least 4 feet into the ground. If possible, living trees should be used as substitutes for one or two of them. They must be placed three feet apart on either side of the mouth of the kheddah and must be as smooth as possible so that the gate rings which are slipped over them will slide down easily when the rope holding up the gate is cut. The actual gate itself is made of stout posts lashed together and it must extend beyond the gate posts as shown in Fig. 3. When open, the bottom of the gate should be about 30 to 35 feet above the ground.

The projecting wings are generally constructed of larger and longer posts than those used as wall posts in the stockade, and placed at intervals of about 1 to 1½ feet apart and strengthened by three series of horizontal securing posts. The length of the wings must depend upon the nature of the ground and type of forest in which the kheddah is situated. They are intended, of course, to guide the elephants into the mouth of the stockade and usually average about 100—200 yards in length.

The observation posts should be constructed in trees at least 30 feet from the ground so that the oncoming elephants cannot sense the presence of the men in them. They should be placed at least a furlong apart on the fire-lines and also at intervals along the route by which the elephants are expected to approach.

ARRANGEMENTS PREPARATORY TO DRIVING.

When the construction of the stockade has been completed and everything else is in readiness the inside of the kheddah should be made to look as much like the natural forest as possible. This can be done by planting grass, bamboos, bushes and branches, etc., here and there and covering the gate and sides of the stockade with them; after this has been done the place should be allowed to remain perfectly quiet for a day or two so as to allow all traces and the scent of human beings to be obliterated.

THE DRIVE.

As soon as all the necessary preparations have been completed the kheddah manager should form his men into parties and assign to each party its allotted task. There should be—

(*a*) a hunting and driving party;

(*b*) a watching and lamp-lighting party;

(*c*) a party of special watchers for the wings and gate.

The duties of the hunting and driving party are to locate a herd of elephants and drive it towards the kheddah. The driving has to be done with great care and as soon as a herd is well on its way towards the stockade a member of the party must hurry back to camp to *inform the manager of the* proximity of the elephants. On receipt of this news the kheddah manager orders the watching and lamp-lighting party to take up its position and await the arrival of the elephants on the fire-lines. Should the herd reach the neighbourhood of the kheddah before sunset it must be carefully and quietly watched till darkness falls, because the actual driving into the stockade is best done by night.

The watchers on the outer fire-line must remain concealed in their observation posts until the elephants have crossed the

line when they must immediately sound their *kaladets*, descend from their trees and light the lamps which have been placed in readiness all along the line. When all the lamps have been lit the watchers of the outer fire-line will join up with the drivers and assist them in driving the elephants over the second fire-line. As soon as this second line has been crossed the watchers on it will descend from their posts, light their lamps and behave in exactly the same way as those on the outer line. From that point onwards all the outer and inner fire-line watchers become drivers and each man with the help of flaming torches, fire-crackers, hollow bamboos and much shouting does his utmost to force the terrified animals into the mouth of the stockade. It is then that the gate-keepers and wing watchers have to keep a careful look-out, for should any animal attempt to charge the wings it must be turned by a gun being fired over its head. In a few moments if all goes well the elephants will have entered the stockade when all the gate-keeper has to do is to cut the rope allowing the gate to fall and close the kheddah thus securing the catch. As soon as the gate is down an alarm signal is sounded to warn the drivers to seek refuge outside the projecting wings from any odd animals that may have been shut out of the stockade and are, therefore, likely to charge back. All the operators then surround the stockade and light bonfires which have been prepared beforehand and give a brilliant illumination in the light of which the catch can be inspected.

On the catch being secured the first thing the kheddah manager has to do is to see whether there is a dangerous tusker amongst the captures. If there is, and it is likely to cause serious injury to other elephants or to the operators, then it must be shot. If, however, it is not particularly dangerous then it should merely be attended to before its more docile companions.

As soon as possible after the drive is over the work of roping and extracting the captures from the stockade should be commenced. First of all the hind legs of all the animals must be secured by means of ropes, passed through the walls of the kheddah, to the compression posts, care being taken that no fore-legs are thus roped.

When this operation has been completed both the fore and hind-legs of all the animals must be fettered. This is done by passing the necessary ropes through the side walls of the stockade with the help of crooked sticks. After their legs have been fettered, the elephants must be further secured by means of ropes passed round their necks, an operation which it is often very difficult to carry out. To facilitate matters it is customary to build a kind of platform above each animal from which two or three men can pass the rope down in front of the beast's head. The elephant, as soon as the rope touches its head usually catches hold of it and putting it into its mouth bites it through. To overcome this difficulty, however, the Karens utter the words Twe! Twe! Bha Tsaw Ay! on hearing which the elephants are supposed to desist from touching the rope. The words apparently signify that the rope has been fouled by fowls and the Karens are firmly convinced that if they are uttered in the Karen tongue no elephant will, on hearing them, interfere with the rope. If, however, the words are spoken in any other language the elephants are believed not to be able to understand them and so the desired effect is not produced.

The neck of each animal when secured is roped to the side wall of the stockade.

Clearing the Stockade.

As soon as all the captures have been properly roped the next thing to be done is to extract them from the main stockade and move them to small training cages *(Thaw Kame)* each of which just holds one animal. For removing the animals a portion of the side wall of the stockade is usually demolished, a hole being made big enough to allow the largest elephant to pass through it. The operation is usually carried out by men alone though occasionally tame elephants may be employed. Long and very strong ropes are attached to each of the animal's legs and to either side of its neck with the help of which the men haul it along and control its movements. The ropes on the hind legs are slightly relaxed whilst men haul on the front ropes, and so step by step the animal is dragged and guided into its cage. Once in the training cage it is secured by bars

FIG. 4. SECOND STEP OF TAMING ELEPHANTS.

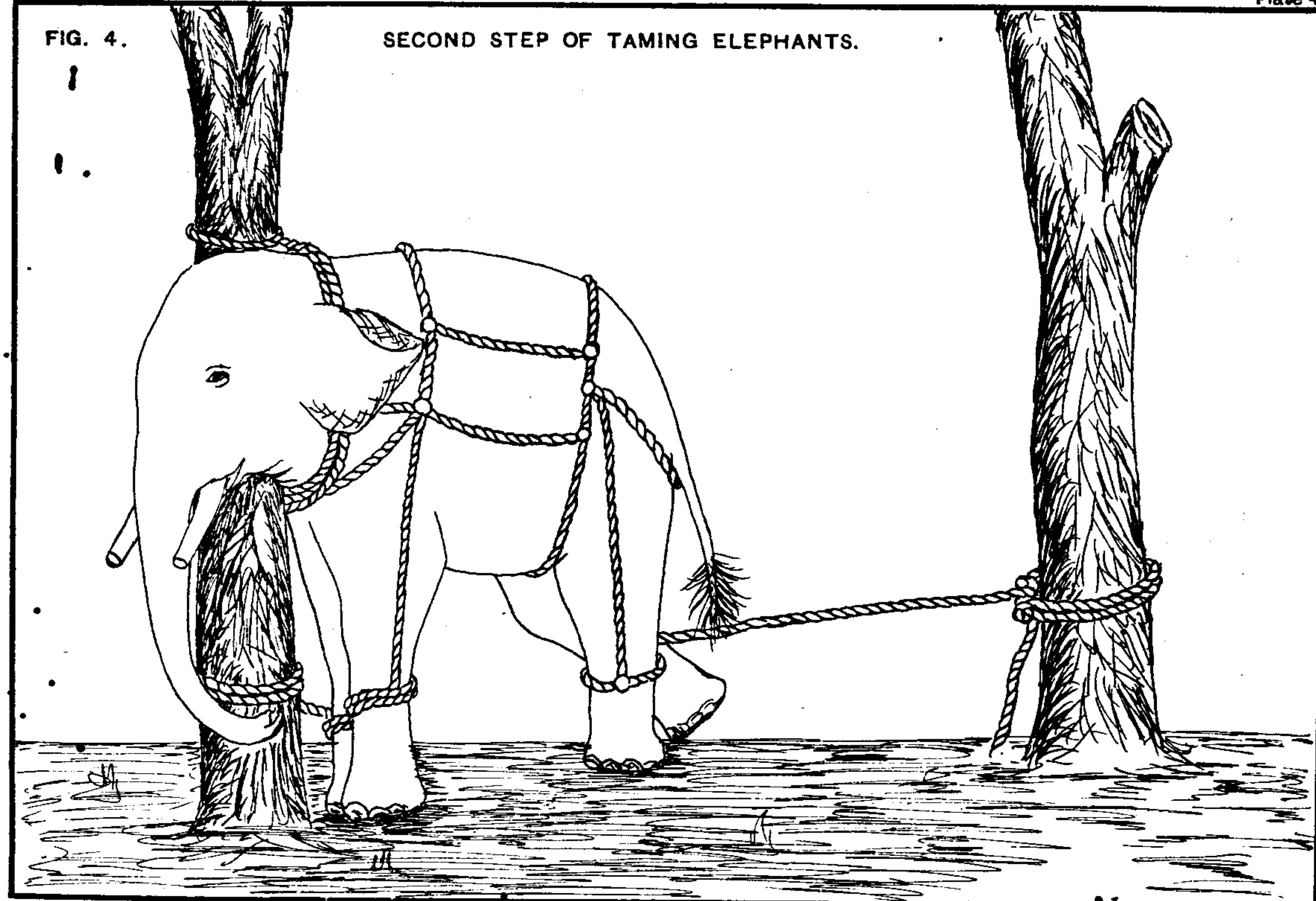


Photo. Zinco. November, 1927.—No. 571-3

placed horizontally under the neck, under the chest close to the fore-legs and under the stomach close to the hind legs. Two more bars are placed at the back and the unfortunate animal is so trussed up that it cannot move in any direction. (See Fig. 3.)

TRAINING THE CAPTURES.

With its enclosure in the training cage the education of the animal commences. The men who are going to undertake the training take up their quarters close to the cage and at once commence to feed, water, handle and pet the animal. All sores, bruises, contusions, etc., sustained during captures must be carefully washed and dressed and everything must be done to keep the elephant in as healthy a condition as possible. Whilst in the cage it should be taught to allow itself to be fettered and unfettered and generally handled by its keepers.

After about three or four days of such treatment it should be possible to dispense with the cage and the elephant should be tied to two trees as shown in Fig. 4.

Whilst tied up to the trees the elephant should be taught to lift its legs when ordered to do so and to allow its keepers to mount on to its neck. It should also be made to walk round a tree by a man pulling a cord attached to a hook placed over its ear. Each elephant must be given a name and it must be taught to come to its keeper when its name is called. It is very important that the keepers should handle their animals as much as possible and so get them thoroughly accustomed to them. Frequent gifts of tamarind, sugar-cane, plantain-stems, salt, etc., will soon have the effect of taming the elephants. Medicine must, of course, be given whenever necessary. A month of this treatment should suffice to tame the average animal and render it amenable to discipline when it can be fettered and let loose in the jungle to forage for its own fodder in the ordinary way with a long tethering chain attached to one fore-leg.

During this month's training the elephant must not be kept tied up in the same place all the time but should be moved to different trees every two or three days. If left too long in one place the ground will become foul or the trees, if small ones, may

become loosened in the ground or uprooted. By continual washing and dressing every effort should be made to get all sores healed up before the conclusion of this stage of the training.

As soon as the elephant is thoroughly tame, healed of all its sores and has completed the first elementary stage of its training, it can be put on to more serious work. It must be taught to proceed in any direction at the command of its mahout, to stop, lie down and get up. Then it should be made to roll and drag logs, commencing with very small ones floating in water and finally tackling larger and heavier ones on rough ground. Great care must be taken not to let the animal strain itself at first and, therefore, the training should proceed by slow degrees, the amount of work that the elephant is given being increased little by little every day. *The training of the animal for baggage work can be under*taken as soon as it is sufficiently tame and this also must be progressively slow.

SOME MISCELLANEOUS NOTES ON KHEDDAH OPERATIONS.

(1) Great care must be taken that the elephants get sufficient and good fodder during their training and until they can be let loose to forage for themselves.

(2) All sores and other ailments must receive continual and careful attention. Failure to wash and dress sores properly is the cause of most of the mortality amongst kheddah captures.

(3) Any tendency towards the development of a bad or dangerous habit on the part of a capture should be checked at once. If this is not done the habit will be most difficult to eradicate in after years.

(4) Elephants like human-beings generally possess individual characteristics. Every animal cannot be treated in the same way, the character of each requiring careful study. Disciplinary action which, if taken against one elephant might prove beneficial, might, if used against another, ruin it for ever.

(5) Elephants require a considerable time in which to recover from the initial shock and strain sustained during capture. Training, therefore, must be proceeded with very slowly, great care being taken not to overdo it.

(6) No animal should be placed on hard timber work until it has been under training and doing light work for at least two years.

(7) A kheddah licensee must see to it that both he himself and all his employees observe all the conditions of the license, that the operations are carried out as humanely as possible and that all reports and returns in connection with the work as required by Government are promptly submitted.

(8) It sometimes happens that it may be possible and advisable to drive elephants from two different directions into a kheddah, in which case a stockade should be made with two mouths and a partition in the centre.

(9) If *koonkies* are employed in the Karen method they are generally used to drag the captures from one tree to another during the month's training immediately following the time spent in the training cage.

(10) In the event of an elephant dying in or near the kheddah, the carcase must be properly buried.

(11) Kheddah captures must be protected against the occasional onslaughts of wild tuskers which may at times attack and kill the roped or fettered animals. Any wild tusker causing damage in that way must be shot.

(12) When recently captured elephants are let loose in the jungle to graze, care must be taken lest they be enticed away by members of a wild herd or killed.

(13) As soon as it can safely be done after capture any elephant which is unfit or too old for hard work or any cow which is heavy with calf should be set free. To attempt to train such animals is most cruel and incidentally unprofitable.

(14) It must be borne in mind that elephants in the wild state are continually changing their diet according to season. In captivity, therefore, they cannot be expected to keep fit if continually fed on the same things. A variety of foodstuffs must be supplied.

A plentiful supply of medicines must also always be kept in readiness.

(15) The captured animals must receive regular attention. They should be rested, bathed, fed and exercised at regular inter-

vals and in fact treated with almost the same consideration as one would treat human beings.

(16) When driving elephants towards the kheddah the operators should keep a look out for tigers which frequently follow a herd on the chance of their being able to kill a calf. If on such occasions tigers are met with and they make no efforts to attack the men then they should be left severely alone ; but if on the other hand they seem likely to become dangerous then they should be shot.

(17) When forcing elephants to enter the stockade all fire-arms used should be handled with great care otherwise an accident can very easily occur. Guns loaded with ball cartridges must only be fired off well over the elephants' heads. Blank cartridges or cases loaded with clay or some soft material are the safest for frightening elephants.

(18) Great care should always be taken to see that no carcases of elephants or any other animals are left lying about near a kheddah. Besides being most unhealthy the smell of putrefaction may cause a recently captured elephant to bolt through fright and be probably lost for good.

AN EXPERIMENT IN GROWING LAC.

I receive so many applications twice a year for *kusum* seed lac, often from places which are at any rate in my mind very little associated with lac cultivation, that it makes me think there must be many others fired, as I was myself a few years back, with the idea that if only they can get lac started in their forests there is a pot of money to be made. I have little to say that will interest the expert, I am just giving my experience on the chance it may catch the eye of some one about to start operations. I do not want at all to dissuade any one from trying experiments, the more the better, and I can say definitely that I do not for one moment regret my own.

How rosy everything looked when first I started, the price was high and the conditions all seemed favourable. Here was a compact area of about 200 acres with about a thousand *kusum*

(*Schleichera trijuga*) trees and a couple of thousand healthy *ghont* (*Zizyphus xylopyra*). In the neighbouring malguzari a certain amount of lac had always been collected ; if with their muddled methods sufficient could be got to make it pay, how much more should I with perfect organization and scientific management gather in at harvest. My area was just alongside the railway and I had the unusual luck of as much labour as I wanted available on the spot, including numbers of women and children, at 4 and 3 annas each, to scrape the twigs, and plenty of small boys who would climb the trees without breaking their necks—or the branches—for 5 annas. Seed lac could be purchased a few miles away, there were quarters standing ready for my staff alongside the area, what more could I want. I thought of a division which turned up with a lakh of rupees of revenue in one year, I dreamt of a niche in the annals of lac, of Bagra lac having a reputation on the market, or receiving the thanks of Government.

The scheme seemed good, the conditions of success were there, I got the funds and bought the seed, I built a three-roomed mansion to house the precious crop, and in it fixed wide couches, stretched with fine meshed wire, on which the lac could rest with fresh air above and below and rid itself of dust; set up a giant balance on a platform to weigh the treasure by the maund so that crafty dealers should not beguile me into weighing seer by seer. I took in weekly quotations from Calcutta and we watched the rise and fall of T. N. and though we still wonder what these mysterious letters mean, we find that if we sell at about ⅝ths of T. N.'s rate we are doing well.

Before we had got very far we had officers from Burma deputed to study how lac really should be grown, and occasionally I got letters asking if I would allow such and such to come and take notes on the methods being followed. One fine day quite early thieves broke in and stole, but they did not catch us napping. Would we compound the case? Not on your life. Jail, nothing less for a crime so heinous. They got pleaders, so did we, we won, they appealed, we won again, and they spent three months in jail.

Our area was divided into five plots and where we did not infect we pruned. To every single *kusum* we gave a tin tablet with a number on it, stamped by steel dies so that it should endure for ever, and when we came to visit say No. 599 we could consult the book of life for his history from the day he joined the chosen, how much of seed lac he had consumed, how much he had yielded up for his less fortunate brethern and how much good dana lac he had put into the till. However hard it rained, and during the Baisakhi crop it seldom does anything else, that book was carried round the area under its umbrella, and with it went a little spring balance, made for weighing mahseer, so that there should be no doubt about the output of each single tree.

At the end of our first season we had our first surprise. These fine fresh trees which we had infected for the first time after pruning seemed to be very sparing in their yield, while other hollow, hoary, old veterans just outside the area, away in the open were laden with the precious incrustation. That year I remember being asked why I did not cut down those old wrecks which disfigured the landscape—I took the critic to No. 193 opened the book and showed the record for one crop, 14 seers, and that at Rs. 2 a seer. Show me your teak tree, I said worth Rs. 28 per annum. But how to make our new recruits bear like the old warriors? We thought perhaps the insect had not been given time to get the upper hand over the virgin sap, and that would come with patience, meanwhile to help the trees we decided to cut down most of the other species round the *kusum* so that they could have the light and air which No. 193 had enjoyed. The following hot weather we noted some gain from this because as soon as *kusum* was opened up it threw out its foliage several weeks earlier than it did when it was smothered up, and those early leaves were what we wanted to keep the sun off *Tachardia* in the hot weather—we were quickly learning how sadly sensitive she and her house were to the direct rays of the sun, before long we got to know that she stood hot weathers worse than any of us, then next she could not stand too heavy

rain, if she was out walking she just got washed away, and again, if suddenly a cold wind sprung up while she was looking for a site for her house, she made no further effort and quietly died.

However sometimes she had a bit of luck with the weather, especially if she was born in the Katki season, though then there was the risk of a snap of frost and that of course was much too much for her, but sometimes she really did get settled in and by February her house was thick and strong and ruddy.

Conservators would come and marvel, say there never was such lac, pat me on the back and think of how their revenue would rise, March and April came along and the bulletins would still be good, then May a note of caution, then June, good heavens, if the rains don't break by the 15th the lac will all be burnt—alas, alack they never break, she is frizzled up, her home all black and burnt. After the hot weather of 1926 I collected 56 maunds of charred remains and three miserable maunds of youngsters

By this time another circumstance had arisen. The first maund of *kusum* lac we ever got in 1920 fetched 105 rupees. As fast as we climbed to 56 maunds, so fast did the price descend to 45 rupees per maund—*Tachardia* is a fickle jade, when your crop is poor she soars in value, when there is anything to sell she drops like a stone. I ask you, therefore, when you scrutinize the statistics, which you will find the most useful part of this note, to look at the total maundage collected rather than at the cash obtained; we have not quite reached the stage when by holding up our output we can control world markets, and was there ever a market more given to violent fluctuations during the last 20 years.

We no longer expect—as no doubt we did at first—that we shall suddenly make a fortune. In every year the elements will play one of their tricks to remind us they are not to be controlled by us, torrential rain when the creatures are crawling, an extra scorching sun before the leaves are there to afford protection, a nip of frost before we are settled in, but even then they are not so unkind that we cannot make a return worth having.

Our total working expenses for collection infection, etc., have risen, with the extension of our operations, from Rs. 250 to Rs. 500 per annum and the staff specially deputed during the two crops is one jamadar on Rs. 25 per mensem and two forest guards on Rs. 14 per mensem.

We are now making a revenue of about Rs. 3,000, our output is increasing slowly and the market is again rising, thus we can close so far as our little experiment goes on a note of confidence. For others about to start we have only one word of warning, look carefully at your maximum and minimum temperatures and be prepared to have your ups and downs, it is worse than farming In a district not far from here where lac is grown on a large scale, the maximum temperature is, I believe, about 110°, whereas here we may get a day or two as high as 118° at Bagra and we are pretty sure to get 115°, and it is, I think those few days which are our greatest handicap. In future I shall keep a record of the temperatures there as excessive heat or cold is an important factor to take into consideration when forecasting the outturn of the coming crop. I have looked up our record trees and find they are :—

					Sr.	Chh.
1923	*Kusum* No.	193	...	...	13	8
1924	"	360	...	...	10	8
1925	"	946	...	...	12	0
1926	"	1085	...	...	24	0
	"	308	...	...	24	0

The date swarming has been observed for both Katki and Baisakhi crops is shown in the table; it is interesting to note how much it varies according to the weather conditions of the year.

H. C. B. JOLLYE, I. F. S.

HOSHANGABAD, C. P.
August 1927.

Lac Statistics. Bagra—

Year.			Baisakhi			
			Date swarming observed.	No. of trees infected at preceding Katki.	No. of trees infected at this season.	No. of trees from which lac was collected.
1			2	3	4	5
1920	...	...	1st July 1920 ...	...	200 K	...
1921	...	...	July ...	121	107 K	321 K
1922	...	...	Do. ...	106 K	95 K	534 K
1923	...	..	2nd July 1923 ...	104 K	318 K	339 K
1924	...	...	7th July 1924 ...	116 K	402 K	357 K
1925	...	...	27th June 1925 ..	269 K	226 K 98 G	447 K
1926	...	...	27th July 1926 ...	127 K 128 G	11 K	571 K 152 G

K = Kusum

G = Ghont

Hoshangabad, Central Provinces.—(contd.)

Crop.					
Dana lac.	Seed lac.	Phunki lac.	Total quantity sold.	Rate.	Revenue.
6	7	8	9	10	11
				Rs. a p.	Rs.
...	2 Mds.	4 Mds.	4 Mds	105 0 0 77 0 0 55 0 0	346
...	6 ,,	2 ,,	2 ,,	84 0 0	168
...	10 ,,	2 ,,	2 ,,	80 0 0	160
8 Mds.	9 ,,	2 ,,	10 ,,	80 0 0	800
7 ,,	24 ,,	5 ,,	12 ,,	78 12 0	955
19 ,,	27 ,,	6 ,,	25 ,,	58 0 0	1,450
53 ,,	3 ,,	3 ,,	56 ,,	44 8 0 35 8 0	2,494

(Schleichera trijuga).

(Zizyphus xylopyra).

Lac Statistics, Bagra—

Year.	Date swarming observed.	Katki: No. of trees infected at preceding Baisakhi.	No. of trees infected at this season.	No. of trees from which the lac was collected.	Dana lac.
12	13	14	15	16	17
1920	November ...	200	121 K	1,200 K	3 Mds.
1921	Do. ...	107 K	106 K	428 K	5 ,,
1922	Do. ...	95 K	104 K	95 K	6 ,,
1923	9th Decr. 1923 ...	318 K	116 K	245 K	[illegible] ,,
1924	27th Nov. 1924 ...	402 K	269 K	501 K	14 ,,
1925	23rd Oct. 1925 ...	226 K 98 G	137 K 128 G	495 K 114 G	24 ,,
1926	13th Decr. 1926...	11	4 K 173 G	168 K 270 G	8 ,,

K = Kusum
G = Ghont

Hoshangabad, Central Provinces—(concld.)

Crop.

Seed lac.	Phunki lac.	Total quantity sold.	Rate.	Revenue.	Totals of Baisakhi and Katki crops for the year. Mds.	Totals of Baisakhi and Katki crops for the year. Rs.
18	19	20	21	22	23	24
			Rs. a. p	Rs.		
3 Mds.	1 Md.	4 Mds.	155 0 0 77 0 0 55 0 0	347	8	693
5 ,,	2 Mds.	6 ,,	84 0 0	562	8	730
4 ,,	1 Md.	7 ,,	80 0 0	560	9	720
4 ,,	1 ,,	3 ,,	80 0 0	240	13	1,040
24 ,,	6 Mds.	20 ,,	76 0 0	1,520	32	2,475
23 ,,	8 ,,	32 ,,	41 0 0	1,312	57	2,762
8 ,,	6 ,,	14 ,,	45 8 0 37 0 0	578	70	3,072

(Schleichera trijuga).
(Zizyphus xylopyra).

SAKSAUL FORESTS OF THE DESERT.

Of the plants useful economically for afforestation of desert tracts there are two species, *viz*:—*Artrophytum arborescens*, Litw. & *A. haloxylon*. Litw. both more generally known under the old name of *Haloxylon ammodendron* before they were established on my initiative in 1912, as two independent species. They belong to the family *Chenopodiaceæ* or *Salsolaceæ*. These two species are the dominant and most important desert trees in the deserts of Turkestan (both Russian and Chinese or Eastern) and yielded in Turkestan up to 1,000,000 tons of firewood per annum. Most of it was consumed locally by the nomads in the deserts, but up to 100,000 tons were exported by railway to practically all the towns, as the best locally obtainable firewood* Outside Turkestan these facts are little known, especially since the old descriptions of *Haloxylon* were very faulty and discouraged attempts on cultivation elsewhere by asserting that it was a very slowly growing tree not exceeding the dimensions of a minor shrub. In 1912 I published in *Samarkand* (Government Edition), an article (as a separate book) entitled "The Southern Kizil-Kums" where I discussed besides geographical items of the Kizil-Kum desert also the main facts concerning desert forest vegetation and in particular the facts about the presence of two species under the long established name of *Haloxylon ammodendron* and their main characteristics. In 1913, the Botanical Museum of the Academy of Sciences agreeing with my view published in its memoirs "D. I. LITWINOW," Genus "Artrophytum,"—Trav. Mus. Bot. Acad. Petersb., 1913, XI, 35., reclassifying the known species and establishing instead of *Haloxylon ammodendron* three species. *Art. arborescens*, Litw. *A. haloxylon* Litw. and *A. amodendron*, of which the first two correspond to the species discussed by me, whilst *A. amodendron* refers to a doubtful form in consideration of formal nomenclature rules. The genus *Arthrophytum* Schrenk was first established in 1845 but had been later replaced by *Haloxylon*. In my article as also in that of D. Litwinow's are

*Saksaul wood was sold and assessed for forest revenue by weight, railway trucks being weighed on scales.

included good photographs dispelling the old idea that these trees were only low shrubs, as seen by travellers, who meet only trees browsed by camels, along all desert highways. The main facts about the desert forests of Central Asia of general interest are these :—

In Turkestan forest-like desert vegetation is met usually only far away from towns, big roads and railways. All easily accessible places are usually devoid of big dendroid vegetation and are covered with moving sand dunes. About the terrors of these, travellers have circulated much exaggerated tales. Usually the belt of moving sand dunes is only 30—50 kil. (20—30 miles) wide and is due mainly to extermination of vegetation by concentrated action of animals belonging to villagers inhabiting adjoining cultivated lands. In the desert there is a much larger nomadic population than the traveller suspects, but such nomads live in tents near their wells which are situated far from big roads. They avoid the neighbourhood of big roads for two reasons :—the vegetation near roads is poor due to damage by animals belonging to caravans, and secondly being Mahomedans they adhere to the old law of the desert in offering hospitality to travellers. They are fond of society but on the roadside the number of guests entertained would be beyond their means. No man can live in the desert without large flocks of sheep and many camels to transport his camp, but he migrates systematically in the area near his well and the vegetation does not suffer as it does from the concentrated action of animals belonging to settled villagers and caravans. The guides taken by travellers from villages never find any nomads in the desert because they themselves are afraid to leave the main roads. The dendroid vegetation consists of *Art. arborescens* and *Art. haloxylon*, *Salsola richteri*, **Ammodendron conollyi* and *Am. karelini*. Out of about 50 species of *Calligonum* only one is a tree, all others shrubs. There are also some minor shrubs belonging to *Chenopodiaceæ* (*Salsolaceæ*) and *Papilionaceæ* (*Leguminosæ*). However the most important trees in all deserts of Asia are *Art. arborescens* and *Art. haloxylon*. They are known

**Ammodendron conollyi* and *Karelini* belong to Family *Leguminosæ* (*Papilionceæ*) and should not be confounded with species *Ammodendron*.

to the nomads as the white *saksaul* (*A. arborescens*) and the black *saksaul* (*A. haloxylon*). In Turki (Turki-Djagatai, or Usbeks the language of Central Asia) :—*Ak-saksaul* (white), *Kara saksaul* (black). Formerly the botanist thought that *saksaul* trees on salines and on sand were different due only to soil. Others could not find a permanent stable difference. Both were wrong. On sand and on salines both species occur and vary the same way in a parallel manner largely due to soil. But on sand, if water is deep only *A. arborescens* is found and on salines, if the soil is hard and very strongly saline only *A. haloxylon*. In all mixed cases, however, on sand and near water or on moderate saline soil both can occur. Most of the strictly botanical differences as stated by Litwinow require microscopical examination. The main difference easily observed and stated by Litwinow refers to the nodes : *A. arborescens* has rudimentary leaves on the nodes (only about 1 m.m. long) whilst *A. haloxylon* has none. Small seedlings have much longer leaves during the first month from germination. However I am not too sure that the presence of rudimentary leaves might not be found in future, an unstable characteristic with some varieties of one of these species. The differentiations found by me are chemical, specific gravity of wood, and vast differences, apparent beyond doubt, as shown on natural size photographs of small branches made in spring, a week before blossoming. Also on dry herbarium specimens the differences are noticeable (of course only on specimens collected in early spring). The internodes between two joints are in the case of *A. haloxylon* covered with a kind of bark which looks like a thick fluffy loose cover of whitish brown felt consisting *of one or two pieces only from joint to joint (from node to node)* whilst in the case of *A. arborescens* the internode has the appearance of having been painted with a thin layer of bad white oil paint and the paint having subsequently cracked in numerous places longitudinally as also transversely. If the paint-like bark is not white it may be covered with black spots (probably of fungus or lichen) the fundamental colour still being white. The point is that this bark disappears during the summer, the nodes disappear and the branch gets a normal dendroid appearance whilst new

young branches get the appearance described during the next winter. Branches older than a year have no nodes and are of the same colour as the stem. Other characteristics are of a less stable nature. It is remarkable that the two species are frequented by two different species of beetles (Coleoptera-Curculionidae gen. Cleonus) *A. arborescens* having a big species coloured white and black, whilst *A. haloxylon* a smaller species coloured brown and black, and I have never met any of them on the wrong species even in cases of mixed occurrence of the two trees. It may be noted, however, that the natives easily distinguish both species and know that only the black *saksaul* yields good charcoal. A hint which will help any traveller is this: examine some trees near salines with adjoining sand dunes: you will notice that the taste of the young green branches is often very bitter (white) and often without any bitterness at all, but strongly saline (black). You will expect that those only on the saline are salty, but soon you will notice that the specimens are mixed and not limited to dunes or saline. A much better occasion for observation is a spring or small river reaching the sands. Even if the water is not saline at all, some specimens will exhibit a strongly salt taste. Gradually you will notice the big difference in the appearance of the two. To give a good description of the appearance is difficult as it greatly varies with soil conditions and both species look often so similar that only close examination reveals the stable characteristics. The *saksaul* trees have practically no leaves as stated already for these are rather rudimentary and noticeable usually only with *Art. arborescens.* The green twigs supplant the leaves so far as chlorophyl action is concerned. The outlines (contours) of a good-growing tree are best compared with a willow tree (*Salix*) up to 33 feet (10 meter) high and with a single stem up to 10 inches (25 cm.) diameter. This applies more often to *A. arborescens* and for this reason it was at my suggestion named "*arborescens.*" The other (*A. haloxylon*) has either several stems (5—6) or if on strong saline then only one, but the tree is then also usually much shorter 15—18 feet high and thicker (12"—14") The wood of the one is light coloured (white *saksaul*) the other, often very dark. Specific gravity of white *saksaul* timber is 1·1

whilst black *saksaul* 1·2 (air-dry-condition) being one of the heaviest timbers known. Both give excellent fuel equal to low grade mineral-coal, and far superior to fir or pinewood.

Excellent results have been obtained in afforestation of sand dunes along the Central-Asian Railway. A stretch of about 200 miles, where trains were formerly obstructed by moving sand dunes has been fixed by cultivating *saksaul* and other plants as *Am. conollyi*, *Salsola richteri*, *Calligonum caput-medusae* and desert grasses. By restricting the grazing of animals, up to 100 tons of firewood can be produced per hectar (2·5 acres) each 20 years, on suitable soil. The established conception that *saksaul* was growing very slowly was founded on the well-known fact that you can count on a cut tree the yearly (annual) rings (layers) of growth. However the procedure proved to be wrong in the case of *saksaul* and evidence of cultivation showed that a tree 10″ in diameter might have upto 80 or more "rings" being only 15 to 20 years old. This tree baffled, therefore, the botanists until the forest service found it out by cultivation. The "rings" correspond merely to periods of increased growth, due as well to rains (5″ per annum) as also to periods of increased differences of maximum and minimum temperatures in 24 hours, when desert sand condenses more moisture from the air at night and salines do the same. A similar phenomenon is likely to be met also with some other desert plants.

Some evidence on the question of moisture condensation below surface is furnished also by the following facts:—The white *saksaul* (*A. arborescens*) grows satisfactory only if either of two conditions is fulfilled: when the sand is loose on the surface and has not, as often happens, been cemented on the surface by loess (clay) dust carried by storms from the loess plains (hard clay like lands between desert and hills). The same condition is met if excessive grazing of animals has again worked the sand loose. The other case of equally good growth is met if ground water is near, in which case the whole surface can be cemented by a hard clay cover without any harm to the rate of growth. The same observation is made also on other desert plants. If the sand is

loose and moving in the shape of dunes, only a few species occur. White *saksaul*, 3—4 species of *Calligonum*, some species of the genus *Aristida* (grasses). If the sand has been stopped in movement by plants but is loose (loose surface) 2 *saksauls*, *Amm. conollyi* and *Amm. karelini*, several *Astragalus* and 40 species of *Calligonum* (shrubs and 1 tree) occur. Many flowers blossom even in midsummer. If sand is cemented on the surface both *saksauls* might occur but only 4—5 species of *Calligonum* and *Amm. conollyi* with several *Astragalus*. However no plants flower later than in May except on salines. Most herbs are dead during summer, some *Artemisia* occur. If not only the sand is cemented but mixed with much clay and the water-level deep the flora is characterised by the appearance of *Liliaceæ* and increase of *Artemisia* in quantity. If the soil is hard loess clay all vegetation is dead by the end of April except perennial *Artemisias*. Then the dominant plant is *Artemisia* often for hundreds of miles. Of *Tamarix* occur 5 species on salines in the desert. All the others (about 30 species) only near the rivers. Except for river valleys (near water level and flood areas) the flora of clay-plains (loess desert) goes up in to the foothills to about 3,000—4,000 feet where vegetation still alive in midsummer again starts. In some places the first dendroid junipers are met at this altitude. Usually, however, juniper hill forests start only from about 6 to 7 thousand feet and go up to about 12—13 thousand feet. *Pinus* and *Abies* forests are rather outside the desert area since the mountain ranges of the Pamir system do not contain any conifers except 9 species of dendroid *Juniperus* and *Pinus* and *Abies* are first met only in the north-eastern corner of the Ferghana valley in the direction towards Sibiria in the mountain ranges joining the Tian-Shan Mountains. The juniper forest in the hills are the counterpart of the *saksaul* forests in the plains. Both have the same geographical range:—From the south-eastern corner of the Caspian Sea where broad-leaved forests of the Caucasian type end till the north-eastern corner of Ferghana near the Chinese border were *Pinus* and *Abies*, *Juglans* and *Pyrus* commence in the northward direction. *Saksauls* are met also in parts of

Kashgaria, the Gobi desert and Tibet and south nearly to the Persian Gulf.

In concluding my observations I must remind that my description of the geographical distribution of various trees does not concern vegetation on river banks. The kind of vegetation known as "Tugai" forest (often several miles wide) consists both in the desert as in the hills, of poplars, *Salix*, wild *Tamarix*, *Betula*, *Halimodendron*, Elaeagnus, apple and apricot trees.

V. PELTS,

Formerly Chief of Perovsk Forest District,
Syr Darya Province, Turkestan.

TREE PLANTING IN SOUTH AFRICA.

BY DR. T. R. SIM.

(Pietermaritzburg, Natal, Witness, Limited.)

Price 15 *shillings*.

Dr. Sim formerly Conservator of Forests for Natal, has produced a book which should do an immense amount of good by drawing attention to the facts regarding the soft wood supply of the world with special reference to South Africa's needs.

South Africa differs from all the rest of the world in this, that having very little natural forest all its forestry energies must be concentrated on the afforestation of new areas. The natural forests suggest diminishing rather than aggressive vigour—the receding survival of more extensive forests of kinds unable to endure present climatic or surface conditions. The timber requirements of the world in general and of South Africa in particular are used to indicate the urgency of the planting problem both on state and private lands. What will be of chief interest to our readers are the chapters dealing with the cultivation of exotics in South Africa more especially the various species of *Eucalyptus* to which nearly 45 pages are devoted. Out of the 350 or more species of *Eucalyptus* found in Australia most have been found unsuitable or unprofitable in South Africa but there remains a considerable list of species which may be expected to do well when given the right soil and climate, among these may be mentioned *Eucalyptus pilularis*, *melliodora*, *Gunnii*, *viminalis*, *rostrata*, *tereticornis*, *rudis* and *Globulus*. The latter has, however been attacked by the Eucalyptus snout beetle. Next in importance to the genus *Eucalyptus* is that of *Pinus*, the most remarkable of which family is of course *Pinus insignis* or *radiata* the Monterey pine, which from being a tree of little importance in its own country has become the outstanding conifer of the

Southern hemisphere. This pine is climatically suited to the forestal parts of the South-Western Cape Province and the sale of a stand 32—35 years old for £397 per acre is reported. These trees were 100 to 140 feet high and 24" to 30" in diameter and we can but wish that our Indian conifers would grow at such a rate. *Pinus excelsa* has been found useless but *Pinus longifolia* has done very well on suitable sites, and the avenue at the mental hospital, Pretoria, is considered one of the seven sights of South Africa. It is a good tree for the thorn veld. The Indian deodar has done fairly well and adapted itself to varying conditions of soil and climate and has established quite a reputation in the Transvaal. Among broad-leaved trees which have been successful may be mentioned *Liriodendron tupilifera*, *Melia Azedarach*, *Grevillea robusta* and *Cedrela Toona.*

A chapter is devoted to ornamental trees, trees for certain localities, trees for the farm, and the indigenous trees of South Africa. We have read the book with much interest and would commend it to all those interested in the acclimatisation of forest trees.

BURMA FOREST BULLETIN No. 15, SILVICULTURAL SERIES No. 11, DECEMBER 1926

Rough Volume Tables (for teak and 9 other species).

This bulletin is the third issued on the subject, the earlier ones being Nos. 6 and 10 published in 1922 and 1923 respectively. Unlike its predecessors it does not carry the name of the compiler which is to be regretted.

Thirty-four of the 49 tables (44 volume tables and 5 tables of length of commercial bole) concern teak, 27 separate tables having been compiled for different localities, and combined regional tables are also given, notably one for the forests east of the Pegu Yoma based on 20,000 trees—the total number measured being some 33,000. This last table is compared with old and new figures for the forests west of the range to show that for large scale estimates a combined table would serve all the teak forests except those of an exceptionally dry type. With each table

is given a brief note of the forest type to which it applies mentioning the associated bamboos, gradients, soil and other matters : this is an improvement on the former bulletins.

The tables give quarter girth volumes to the nearest cubic foot without bark for the mean trees of 6" girth classes and 2" diameter classes. These specifications might usefully have been repeated over the important tables. It is shown that if the right table is used estimates should be within 10 per cent of actuals. Further tables are published for *Xylia dolabriformis* (1,457 trees in two localities), *Dipterocarpus tuberculatus* (670 trees in two localities) and *Terminalia tomentosa* (628 trees) amplifying those of Bulletin 10, and indicating in all cases that for these species there is a very big range in different localities ascribable either to differing quality class or intensity of extraction.

The Volume Tables for *Heritiera fomes* (562 trees), *Lagerstroemia* species (148), *Adina cordifolia* (260), *Pterocarpus macrocarpus* (660), *Vitex pubescens* (141) and *Pentacme* (1,343) are important as the first published for these species.

H. G. C.

INDIAN LEECHES.

HIRUDINEA, BY W. A. HARDING AND PROF. J. PERCY MOORE,

Fauna of British India, 1927, Taylor and Francis, London.

In the latest volume on the Fauna of British India Mr. W. A. Harding and Prof. J. P. Moore deal with the *Hirudinea*, or Leeches, of which 46 species are recorded from India, Ceylon and Burma. The external morphology and internal anatomy are described in considerable detail and illustrated with 63 text-figures that are admirable in drawing and reproduction. There are also nine very successful plates in colour or half-tone depicting the characteristic forms of land-leeches, cattle or horse-leeches and other parasitic water-leeches.

A preface is contributed by the editor, Sir Arthur Shipley in which are collected allusions to leeches as blood-suckers or to their use in medicine from early sources in Chinese and Assyrian literature up to the beginning of the nineteenth century, when

the traffic in medicinal leeches was at its height, and on to the outbreak of the Great War, when the supply of European leeches failed and imports had to be made from India. The extensive areas of swamps together with the cultivation of rice, the use of domestic animals that enter water, the habit of the natives of going bare-footed and in most parts of the country the twelve months of growing weather make India most favourable for the development of leeches. As may be expected there are numerous references to leeches and blood-letting in Sanskrit literature. The word "Jalauka" for leech appears first in the Mahabharata which probably dates from 500 B.C. The preface will be appreciated by all who have read "Pearls and Parasites" and "The Minor Horrors of War."

The voracious land-leeches with which the forest officer comes into most intimate contact belong mainly to the genus *Haemadipsa* of which Prof. Moore recognises five species, splitting up the widespread *H. zeylanica* into sub-species for (*a*) Ceylon, (*b*) Cochin State, (*c*) the Western Himalayas especially Almora and Kumaon, (*d*) the Eastern Himalayas with Sikkim and Assam. Another species *H. Sylvestris* is common in Burma, Assam and Bengal. But although forest officers have better facilities for collecting leeches, or at any rate observing their habits, practically the whole of the material on which the present monograph is based was obtained by professional zoologists. Prof. Moore notes that "in view of their abundance, ubiquity and assertiveness it is surprising how little accurate information concerning land-leeches we have. It is well known that they are most active at night and during rainy weather and that most of them will disappear during a few days of no precipitation and that during the dry season they totally disappear, but no one appears to know what actually becomes of them during the dry season. This was the answer invariably received from Indian naturalists to whom the question was put."

We commend the volume to those who would learn more about a loathed enemy and his kind or who want a field of biological research based on a sound systematic foundation.

C. F. C. B

FOREST ENTOMOLOGY IN AUSTRALIA.

FOREST INSECTS AND TIMBER BORERS, BY W. W. FROGGATT, F.L.S.; pages 107, 1 coloured and 30 line plates; Sydney, 1927.

It is only during the last few years that serious attention has been given to the study of forest insect conditions in Australia. The first official step was taken in 1923 when the Forestry Commission of New South Wales published a book entitled *Forest Insects of Australia* compiled by Mr. W. W. Froggatt at the completion of over thirty years' service as Government entomologist to the Department of Agriculture. This was followed by the appointment of Mr. Froggatt as Forest Entomologist to the Commission for the period of one year subsequently extended up to the 31st March 1927.

The present book under review represents the results of his work since 1923, and takes the form of a series of illustrated articles which originally appeared monthly in *The Australian Forestry Journal.* While this has permitted the reproduction in book-form of thirty of Miss E. A. King's excellent full-page line plates it has the disadvantage of a most inconsequential arrangement of subject-matter.

Of the fifty-five subjects listed in the "Contents" forty-seven deal with timber borers and their associates—a higher proportion than one would expect from the title of the book—*Forest Insects and Timber Borers.* In a preliminary survey of this nature the species dealt with obviously form only a tithe of the forest insect fauna of the country and the information recorded is necessarily restricted to elementary facts in their biology. Mr. Froggatt does not appear to have been able to devote much time to the consideration of control measures or to experimental work, but he makes the statement (p. 2) that timber merchants in New South Wales, Borneo and the Philippines have found that spraying or painting logs with an adhesive repellant mixture of creosote, tar and oil, as soon as they are felled in the forest, is a satisfactory method of preventing the attack of pin-hole and shot-hole borers.

We have frequently advocated this measure for use in India and are interested to find that the first evidence of its successful adoption comes from other countries.

Recent imperial and colonial conferences have emphasised the value of co-operation between the various parts of the British Empire in common fields of research. In tropical forest entomology Australia and India have much in common and should contribute much that is of mutual benefit.

To this the economic importance of the timber borers in the families *Bostrychidæ*, *Platypodidæ* and *Scolytidæ* bear witness. The bionomics of these insects have been extensively investigated in India and it is safe to predict that the general principles will be found to apply to conditions in Australia. It is interesting to note that the ecological work done on the *toon* shoot and fruit borer at Dehra Dun forms the basis of the knowledge of this species in Australia, where it is known as the red cedar tip moth, and in Java where it is called de mahonie-topboorder.

Without wishing to minimise our appreciation of the book and the circumstances that have produced it we cannot avoid drawing attention to the numerous printer's errors, the frequency of unqualified phrases such as "last July," "this year," or deprecating the description of new species in a publication of this nature (*e.g.*, *Dilachnus callitris*, on page 56; and *Aressida imperialis* on page 55 — in fact it is not clear from the text whether the latter is or is not identical with *Aressida nigricornis* Cam.; and *Platypus froggatti* Samps. on page 79, and plate XXIV, figs. 7 and 8 is an *in litt.* name and the authorship therefore devolves on Mr. Froggatt).

C. F. C. B.

FOREST PRODUCTS—THEIR MANUFACTURE AND USE.

BY NELSON COURTLANDT BROWN, B.A., M.F., (MESSRS. CHAPMAN AND HALL, London, Price 20*s*).

This is the second edition of this work in which the latest processes of manufacture are described and the information regarding statistics and prices brought up to date. The book deals with forest utilisation as a whole, apart from lumbering, and

each particular item is dealt with in a separate chapter, so that the book becomes a useful work of reference. In spite of the fact that the book applies chiefly to American conditions many subjects of present importance to Indian Foresters are dealt with, such as wood pulp and paper, tanning materials, veneers, wood distillation, charcoal, etc. In considering any of these industries it is by no means easy for the ordinary forester to obtain such information in a handy form, such as this book provides, and we think many of our readers for this reason would be glad to add this volume to their libraries. In addition there are chapters dealing with cross ties or sleepers, maple syrup and rubber. With reference to sleepers the specifications of the leading American railways for their sleepers will be of much interest to our readers. It will be seen that these railways accept a class of sleeper which no Indian railway will take. The illustrations on page 264 show sample sleepers with the centre of the tree in the middle which is strictly forbidden in Indian contracts. The prices for best quality untreated hardwood sleepers 8′6″ × 7″ × 8″ vary from $1·25 to $1·50 f.o.b. cars which is less than the price of sal in India.

If Indian railways would only modify the onerous conditions they impose in their specifications they would obtain a cheaper article in greater quantities and the wastage in forest conversion would be much reduced.

EXTRACTS.

SUITABILITY OF TEAK FOR VENEER.

The average wood user does not classify teak among the kinds that are ordinarily in request in veneer form. Its principal use is in shipbuilding and especially for decking. Yet teak can be sliced or rotary cut as easily as any other hardwood states a contributor in an American trade paper. It is more porous than Spanish cedar and there is no difficulty in knife-cutting it as thin as 1/30 in. For flooring it is generally reduced into thin boards of ¼ in. Only the highly figured flitches are

cut into very thin veneers, for which there is a demand for special work, which is constantly on the increase in the United States. Much of this is used in the interior trim of fancy cabins in the small pleasure boats and larger yachts. The use of teak is on the increase generally, and especially for flooring in very fine residences, club rooms and bank buildings.—[*Timber Trades Journal, 8th October 1927.*]

THE AUSTRALIAN FORESTRY SCHOOL.

The 11th April, 1927, deserves to be remembered as a red-letter day in the annals of Australian forestry. On that date the newly completed Forestry School at Canberra opened its portals to forestry students hailing from every State in the Commonwealth. The six States had at last shown their realisation of the pressing need for the professional training of their foresters, and by their co-operation had made possible the idea of a national forestry school.

The motto chosen by Mr. Jolly for the school flag, "*Mihi cura futuri,*" is particularly appropriate. To the forester is entrusted the care of the future, and it is a mighty trust, calling for the highest training.

The site chosen for the school at Westridge, the western suburb of the Capital City, is an excellent one. Facing eastwards, the school occupies a commanding position almost on the crown of a rise, with "Westbourne Woods" immediately behind. On the eastern side the view is entirely unobstructed and, as seen from the Cotter road, the school building presents a very imposing appearance.

The building is rectangular in shape, measuring 165 feet by 55 feet, and contains a spacious museum, library, two lecture rooms, laboratory, drafting room, principal's room, lecturers' rooms, etc. The main entrance leads into a lofty octagonal hall, which occupies the centre of the building

The timbers used in construction throughout, including concealed timbers, are Australian hardwoods and softwoods

In the floors and interior panelling timbers from every State are seen to great advantage, and the parqued floor of the octagonal hall provides a perfect demonstration of the handsome pattern effect obtainable with our different coloured hardwoods. The furniture also is entirely made from Australian woods. The building as a whole, therefore, constructed from floor to rafters with Australian woods, panelled and furnished with Australian woods, provides a most effective ocular demonstration of the general all-round utility of the home-grown product. From this the uncontrovertible fact emerges that, given proper discrimination in the selection of our native timbers for specific uses and suitable seasoning methods, the widespread prejudice against their use is wholly indefensible.

The laboratory and teaching equipment generally is of the most up-to-date type. A library is rapidly being built up which, already containing the most extensive range of forest literature in Australia, will in the years to came take an honourable place amongst the forest libraries of the world, and as one worthy of Australia.

The teaching staff, under the energetic personal direction of Mr. C. E. Lane-Poole, who temporarily combines the office of Principal with that of Inspector-General of Forests to the Commonwealth, is composed of three lecturers—Mr. C. E. Carter, B.Sc. (Melb.), M.F. (Yale), from Victoria; Mr. H. R. Gray, M.A., Dip. For. (Oxon); and Mr. A. Rule, M.A., B.Sc. (Aberdeen), from Western Australia. Surveying is at present taught by Mr. G. W. Nunn, a licensed surveyor studying for the forestry diploma. As the institution grows, and a permanent Principal is appointed, it is hoped that the present staff will be augmented sufficiently to allow specialisation in the many and varied branches of a wide curriculum.

In regard to field training, the school is also fortunately situated in that demonstration areas are readily accessible. "Westbourne Woods," in the immediate precincts, is an arboretum of native and exotic species, established by Mr. Weston, M.V.O., from 1913 onwards, which will prove invaluable for field demonstration in conjunction with lectures. Westridge Nursery, situated,

about half a mile to the west of the school, which at present supplies the planting stock for afforestation operations in the Federal Territory, is at the disposal of the school for practical training in nursery work. This nursery, in addition to the area devoted to the raising of forest trees, supplies all the decorative trees, shrubs, and plants required by the Parks and Gardens Department, and contains an arboretum where native and exotic species are grown singly or in clumps. Students, therefore, in addition to maintaining close contact with seasonal nursery operations, will be able to study the growth and habits of the various timber species represented in the arboreta.

Through co-operation with Mr. G. J. Rodger, B.Sc., Chief Forester to the Federal Capital Commission, scope is also provided for the study of the general management of the indigenous forests and preparation of working plans. The Coree-Condor area, on the Brindabella road, is at present being surveyed by the students, and an assessment is to be carried out in the forests of *Eucalyptus fastigata* and *Eucalyptus gigantea*, extending from 2,500 to 3,500 feet elevation, with a view to tackling the problems of their future management under working plan.

Valuable field experience will also be gained in the preparation of planting plans for the area which the Federal Capital Commission, through its Chief Forester, has set aside for afforestation within the next decade.—[*The Australian Forestry Journal, May* 1927.]

[*The following extract from "Journal of Agricultural Research" (Government Printing Office, Washington, U. S. A.) for August 1st, 1925, may be of interest to forest officers in the Himalayas.—Ed.*]

BEST TIME FOR SOWING SILVER FIR IN THE NURSERY.

(BY J. V. HOFMANN, FOREST EXAMINER, WIND RIVER FOREST EXPERIMENT STATION.)

Introduction.—Early attempts to grow silver fir (*Abies grandis*) at the Wind River Nursery, Carson, Wash., resulted in almost

complete failure. One exception, however, was a successful sowing in the late spring. Since the previous losses were nearly all due to damping off, this singular success was attributed to the later date of sowing and the inactivity of the damping-off fungi after the soil had warmed. In order to correlate successful germination with the time of sowing and soil temperature, the following experiment was undertaken.

Method.—The unit seed bed area used was one-half of a standard 4 feet by 12 feet bed, making the unit 4 by 6 feet. The first bed was sown on November 16th; the second on March 25th of the following spring, the earliest date it was possible to work the soil. The series was then continued at about 10-day intervals.

The seed used was gathered in the fall just before the first sowing, at Red Mountain, on the Columbia National Forest, at about 4,000 ft. elevation. It was extracted by air drying where gathered, and was then shipped to the Wind River Nursery and stored in sacks in a cool, dry room. A cutting test on November 15th showed the seed to be 39 per cent. good, 10 per cent. wormy, and 51 per cent. bad. Another cutting test March 21st following showed 36 per cent. good, 12 per cent. wormy, and 52 per cent. bad. There were 12,550 seeds per pound. Sowing was at the rate of 2,500 good seeds per bed, based on weight and cutting test.

The fall-sown bed remained unshaded, as did the spring-sown beds, until the middle of June, when 50 per cent. shade was applied. The shades were left off to prevent damping off and to produce a warmer soil in the seed beds.

The seed beds were not allowed to become dry but the watering was done at a time when the surface would dry soon after, to prevent damping off.

Soil-temperature readings were taken at 1-inch and 6-inch depths at intervals of about three days.

Germination, mortality, and survival counts were taken daily from April 17th, one week before germination began, until August 15th, the close of germination. These counts were made in three

areas in each bed, each area being 2 feet by 6 inches. Hence 3 square feet were counted. These areas were permanently marked with pegs and cord at the time of sowing. The seedlings were marked with coloured toothpicks, each colour indicating a one-week age class. Causes of mortality were determined by cultures from dead or dying seedlings.

Notes on terminal-bud formation and on second growth were taken September 3rd, and November 6th.

After the close of the growing season weights and measurements of the top and root development of the seedlings taken from 25 plants arbitrarily selected from each bed, were recorded.

Results.—A general correlation of soil temperature and germination of seeds is established. When the soil temperatures and the period of best germination in Table I are related, definite relations between soil temperature and germination are seen, although specific instances differ. The periods of best germination for the sowings of March 25th and April 4th are shown to be later than those for the sowings of April 13th and April 25th. This condition emphasises the danger of early spring sowing because of the long dormant period of the seed and the consequent exposure to damping off. The month of May was unfavourable to germination, and the periods of best germination, were after the soil had warmed. Likewise the best germination period of the fall sowing came when the soil was warmest in the latter part of April and early May. The general indications of the spring sowings are that germination does not proceed at its best until the soil temperature is 70° F. or warmer to a depth of 6 inches. Surface temperature may be higher, but a cooler soil below the surface causes rapid and extreme fluctuations at the surface and the seed does not get the benefit of a high enough temperature for good germination.

The fall sowing resulted in the greatest germination and also the highest percentage of survival, as shown by Table I.

Table I.—Effect of time of sowing on germination and bud maturity.

Time of sowing.	No. of days before germination.	Two-week periods of best germination	Total germination per square foot.	Percentage of buds mature. Sept. 3.	Percentage of buds mature. Novr. 6.
			Number.	Per cent.	Per cent
Nov. 16, 1917 ...	At least 30 days in spring.	Apr. 23—May 6 ...	52·5	88	100
Mar. 25, 1918 ...	73	June 20—July 3 ...	20·8	73	100
Apr. 4, 1918 ...	64	June 21—July 4 ...	28·2	85	100
Apr. 13, 1918 ...	58	June 17—June 30 ...	24·9	71	100
Apr. 25, 1918 ...	53	Ditto ...	23·8	63	100
May 4, 1918 ...	51	June 24—July 7 ...	29·1	24	100
May 20, 1918 ...	35	Ditto ...	28·2	6	98
May 31, 1918 ...	38	July 15—July 28 ...	27·2	11	95

The losses were due almost entirely to damping off, practically all those indicated by the cultures being caused by *Pythium debaryanum. Rhizoctonia* sp. was found in a few cultures later in the season.

Germination proceeded quite uniformly in each bed after it began, with the exception of the fall sowing. Although weekly records vary, all of the spring sowings were quite uniform in final germination, with slightly wider differences in survival. The dormant period of the seed in the seed bed was very much shorter in the later sowings. This is an important factor, as it reduces the period of exposure to damping off. The fall-sown seedlings matured their buds earlier, although this season the buds of all the seedlings matured. The first killing frost came in November, while usually the first frosts occur in early October. In an

average fall the buds of most of the spring-sown seedlings would have been immature and subject to injury by frost. There was no tendency to develop second growth in any of the stock.

Table II.—Effect of time of sowing on development of seedlings.

Time of sowing.	Weight of entire root system.	Weight of root system pruned to 5-inch length.	Secondary roots.	Length of root.	Weight of top.	Length of top.
	Ounces.	Ounces.	Number.	Inches.	Ounces.	Inches.
Nov. 16, 1917 ...	0·56	0·52	11	6·3	0·60	1·4
Mar. 25, 1918 ..	·28	·28	2	3·8	·48	1·0
Apr. 4, 1918 ...	·36	·36	4	5·6	·44	1·0
Apr. 13, 1918 ...	·28	·28	2	4·1	·48	1·1
Apr. 25, 1918 ...	·24	·24	2	4·8	·48	1·3
May 4, 1918 ...	·24	·24	1	3·9	·40	1·0
May 20, 1918 ...	·20	·20	1	4·2	·36	1·0
May 31, 1918 ...	·16	·16	1	2·3	·28	1·0

The fall sowing produced by far the best developed plants, as shown in Table II. The plants were larger, more sturdy, and had a well-developed, branching root-system. The plants of the spring sowings showed only normal variations, except the late sowings of May 20th and May 31st. The uniform development of all of the other sowings was no doubt due to the delayed germination of the earlier sowings and the optimum germination of all of these sowings at approximately the same time.

Summary.—The results of this experiment show that the best developed and hardiest plants result from fall sowing. Simply on the basis of plant development fall sowing would be recommended, but the danger of damping off complicates the question. There is always the possibility of loss by damping off. Spring sowing should be done not earlier than the last week of April and not later than the second week in May, in an average season.

GAME PRESERVATION IN EAST AFRICA.

MENACE OF SLAUGHTER FOR PROFIT.

Captain Keith Caldwell, the Acting Game Warden in Kenya, in the course of a recent lecture before the Kenya and Uganda Natural History Society, which was attended by the delegates to the Inter-Colonial Agricultural Conference, issued a warning to the Colony regarding the growing menace to game preservation through the activities of the "profit-killer."

He declared that an increasing number of people were turning to game killing as a living. They were doing incalculable damage and were taking advantage of every loophole in the Game Laws. He explained that the law prohibiting the export for profit of hides or trophies, except ivory and rhinoceros horn, had worked well in the past, but a local market had now grown up, and such things as buffalo hides were now of considerable value, while farmers required game meat for labourers' rations and there was also a trade in young animals.

Speaking particularly of the ivory trade, Captain Caldwell said that the high price of ivory and the facilities provided by improved transport had made the business enormously profitable, and elephants with 100lb. tusks were becoming more and more rare. The lecturer told of the result of the endeavours of the Government of Uganda to protect native holdings from elephant raids by providing a system of permits to any white man to shoot two animals a day and retain two of the tusks. One European, who found that elephants were no longer doing damage in his district, paid a native to dig up roots and stamp on the ground of his garden with stuffed elephant feet. That state of affairs, which led to the destruction of large and valuable elephants, had been stopped by the appointment of official elephant-hunters. In a reference to the illicit trade into Italian Jubaland, Captain Caldwell said that the new border was the greatest asset to the ivory runners, and whereas an average of a ton of ivory a month came at one time form the Tana River area, for two months the returns to the Game Department had been nil.

The Game Warden declared that the quickest way to wipe animals from the face of the earth was to commercialize their trophies, and he instanced the case of zebra as an example of the liability to abuse of special facilities. Issues of free ammunition were made to settlers in farming districts to enable them to reduce destructive herds of zebra, but it was found that zebra hides could be exported at a profit. The "profit-killer," who is not the farmer, took advantage of the position to kill indiscriminately in non-settled areas, and 12,000 were killed in one area alone. Buffalo hides, used by the Kavirondo for making war shields, were also a source of profit, and both in the case of the zebra and the buffalo the "profit-killer," from a safe position, fired volleys into herds, caring nothing about the number of wounded animals allowed to escape. He also expressed the opinion that if slaughter of game for meat supplies continued to be allowed on Crown land there would be no game at all in four or five years. He stated that the Department was now issuing six licenses for every one granted formerly.

Captain Caldwell's most interesting proposal was that there should be an international agreement on the preservation of African game. He suggested that the League of Nations should take a definite interest in this preservation, appointing an officer to bring to light all abuses of any agreement. He suggested that the position would be improved if ivory were made a Government monopoly.—[*The Times.*]

SOME OLD INDIAN SPORTING BOOKS.

(BY R. G. B.)

When the old hunter has retired from the scene of his activities, he has many things to remind him of the days that are no more. There are trophies of skins and horns, each with its history to be recalled in the years of rest and leisure. There stands in the corner of his library the old rifle with which he ranged the jungles for so many years, beginning perhaps half a century ago. There are the old maps with routes marked on them, over which he may have ridden seventy or eighty miles

between sunrise and sunset, and on which camping grounds are indicated and letters of the alphabet recall the spots where the more notable game—tigers, leopards, and bears—were killed. In one comparatively small area eighteen tigers are marked; in another the scattered P's show that twenty leopards were slain. Then there are sporting diaries and other literary records, including books of cuttings of articles on sport and natural history contributed to "The Pioneer," "The Field," "Natural History Journals," and the defunct "Asian" over a long series of years.

THE LIBRARY.

In the course of years, too, the old hunter probably collects many old books dealing with his favourite pursuits. In my own library I find quite a considerable space occupied by such volumes, among which the bound journals of the Bombay Natural Society, a mine of information and interest, from the inception of the Society in 1886 to the present date, occupy a prominent position.

The earliest authoritative work on Indian sport is Captain Thomas Williamson's Oriental Field Sports, a scarce and valuable work published in 1807, a good copy of which may be worth from £30 to £40. The original edition of this book, in folio size, contains forty coloured plates from spirited drawings by Samuel Howitt, depicting the hunting of most of the wild animals met with in India. It is quite the most prized volume in the collector's library.

A DECLINE.

There are many volumes of three defunct sporting magazines which indicate how the sporting literature of India has declined during the past fifty years. "The Oriental Sporting Magazine" was published between 1828 and 1877, including a period of inanition. "The Bengal Sporting Magazine," 1838—1842, contains many matters of great interest to the sportsman and naturalist. It would be an advantage to the sporting world if one of these publications could be revived, such as the India Sporting Review, issued between 1845 and 1856. It contains among other good things some excellent articles on the feline animals

of India by Zoophilus, who may perhaps be identified with the celebrated naturalist, Dr. Jerdon. A famous book, "The Old Forest Ranger," by Colonel Walter Campbell, was published in 1842. Campbell went to India with a Highland Regiment in 1830 and has given a spirited account of his voyage to India and of his life in the East in another book—" My Indian Journal," published in 1864. The " Old Forest Ranger " is a mixture of fact and fiction related with a humour which is not always found in a Scot, but perhaps he owed this to his English mother. His books are well-illustrated with the old-fashioned engravings which are so much more attractive than the photographs which have superseded this kind of illustration.

A FINE FIGURE.

A small book, "The Wild Sports of India," by Major Henry Shakespear, is dated 1862. The frontispiece shows the author, a fine figure of a man with a beard nearly down to his waist. He gives a remarkably graphic description of two man-eating tigers which he killed in the Central Provinces. Shakespear was a bold sportsman who met with many accidents; his wife used to complain that he was constantly being brought home on a litter owing to injuries received in pigsticking or shooting. His book contains a dissertation on the Arab horse and other breeds used in India and on Irregular cavalry. He served in the Nagpore Irregular Force, and in the cavalry of the Hyderabad Contingent, described by Lord Gough, Commander-in-Chief, as "the best irregular horse in the world." When in the Nagpore Force he wore a remarkably resplendent uniform, and used to ride to mess mounted on a small elephant.

A scarce volume is "The Eastern Hunters" by Captain Newall, published in 1866, in which the author gives an excellent account of tiger and bear-shooting. It is not easy to get, and a good copy is worth from *7s.* to *10s.* A well-known Nilgiri sportsman, Colonel Douglas Hamilton, wrote a good series on sport in Southern India for the "South of India Observer." These were republished under the title of "Game" at Ootacamund in 1876, but I have been unable to obtain a copy. In the same year

Colonel A. A. Kinloch produced his fine work on the "*Game* Animals of India."

OTHER WORKS.

A fine naturalist and good sportsman was the late R. A. Sterndale, one of the founders of the Bombay Natural History Society, who became Governor of St. Helena after a long career in India. In 1877 he published "Seonee," a pleasant narrative of sport in that district of the Central Provinces. It contains much information on the habits of game animals. The author a few years later produced his "Natural History of the Mammalia of India," a work far preferable to more pretentious publications, for the author was a keen and accurate observer of nature, and not a mere compiler like many of those "scientists" who, as Robert Louis Stevenson says, "write of the world as if with the cold finger of a starfish." The same year that "Seonee" was published also saw the appearance of Baldwin's "Large and Small Game of Bengal," a valuable book, also the work of a sportsman-naturalist.

IMAGINATION.

Another book worthy of mention is "Sport in Many Lands," by H. A. L., the Old Shekarry. The author was Major H. A. Leaveson, who died in 1875 after what was apparently a somewhat adventurous career. The volume is well-written and gives a considerable amount of accurate information on the subject with which it deals. A large part of the book relates to sport in India, and the author must have been a clever man, for he describes in detail events in which he certainly never took part, although he professes to have done so. He joined a Madras regiment about the year 1845, but did not stay long in India nor did he do any big game hunting while there. This, I was told by an officer who served in the same regiment with him in the forties of the last century, whose name he quotes constantly as having been with him on imaginary expeditions which he describes, but which in reality did not take place.

In 1879 was published Sanderson's "Thirteen years among the Wild Beasts of India" one of the best of the long series of

books of this kind. The description of the habits, the hunting, and the capture of the elephant is alone sufficient to establish the value of this volume, and it contains one of the most vivid and thrilling accounts of a man-eating tigress to be found in sporting literature.

Valentine Ball's Jungle Life in India" appeared in the following year, a most interesting work dealing not only with sport but with many matters of general interest as the title suggests.

We have now come within our limit of fifty years ago for old books, but many published more recently deal with days of long ago. There is, for instance, "Reminiscences of Sport in India" by General E. F. Burton published in 1885. The author joined the Madras Army in 1840. He was a keen observer of wild life as well as a hunter of large and small game.—[*The Pioneer, 26th February 1927.*]

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REGENERATION OF INDIAN OAKS.

The regeneration of Indian oaks has from time to time come under the consideration of Indian foresters and frequently, more especially with ban oak (*Quercus incana*), very little success has been attained, either with natural or artificial regeneration.

In this connection it is with some interest that we have read Bulletin No. 19 of the School of Forestry, Yale University, in which Mr. Clarence F. Korstian publishes an investigation into the factors controlling germination and early survival in oaks.

Starting with an historical review of the investigations which have taken place in Europe, from which the advantages of autumn sowing are only too apparent, the author proceeds to quote Professor Troup on the germination of the Indian oaks. These conclusions of Troup on pp. 918—921 of his "Silviculture of Indian Trees" deserve study by all who have to do with this oak. From his investigations the importance of covering the seed, autumn sowing of the acorns and shade is apparent, yet acorns are still being sown in June after being collected and stored in sacks from the previous autumn. Surprise and resentment then follow on a complete failure of the forester's effort.

These results of Troup's and the European investigations are confirmed by the bulletin we are dealing with, some of whose conclusions are as follows :—

1. In many cases, particularly in those of limited seed production, 90 to 100 per cent. of the available supply of acorns may be consumed or otherwise destroyed by animals, especially the seed-eating rodents.

2. The extent of insect injury, mostly by nut weevils, was found to vary from no injury on certain chestnut oaks to over 50 per cent. on some black oaks.

3. Acorns cannot withstand the amount of heat usually generated in leaf litter fires.

4. Large, heavy acorns were found to give the highest germination percentage and also the largest and most vigorous seedlings at the end of the first year.

5. A moderately low temperature (33—38°F.) and high atmospheric or high soil moisture are the most important factors controlling the retention of the viability of acorns in either artificial or natural storage. A supply of oxygen sufficient for respiration must also be available.

6. The radicles of germinating acorns are unable to penetrate soil which has become excessively compacted at the surface.

7. The leaf litter cover of the forest floor is of the greatest importance in producing an environment most suitable for acorn germination and the survival of the seedlings. This is due to the influence of the leaf litter in reducing water loss, equalising temperatures, and facilitating root penetration.

8. Optimum seed-bed conditions can be maintained and the natural regeneration of oak by seed most easily secured by a form of partial cutting, either by the selection method or by the shelterwood method in which the stand is removed in two or three cuts.

From this it is beyond doubt that all sowings of ban oak should be made in the autumn and winter. We have seen considerable success follow such practice and it is just as easy to do the work then as to delay it till June or July.

Other oaks such as *Quercus dilatata* and *Q. semecarpifolia* ripen during the rains and immediately germinate, and such oaks must of course be sown straight away.

AFFORESTATION IN NEW ZEALAND.

Forestry in New Zealand has become, as in Great Britain, very largely a question of afforestation. The total area of State forest plantations, as given in the latest annual report of the State Forest Service for the year ending 31st March 1927, is 98,891 acres and the goal to be reached by the Forest Service is given as 300,000 acres by 1935. After a generation of experimentation certain exotic pines notably *Pinus insignis* or *radiata* have been finally tried out and the efforts of the Forest Service are now chiefly confined to the planting of these pines together with the Douglas fir and *Cupressus macrocarpa*, *C. Lawsoniana* and *Thuya plicata*. Eucalypts from Australia have also been found most successful. It is a matter of regret that little is mentioned of such fine native trees as *Agathis australis*, the far famed *kauri* pine, or of the various species of *Podocarpus*. It is presumed that these are not sufficiently rapid in growth to be able to compete financially with *Pinus radiata*. Still we think that the State Forest Service should consider the merits of the valuable native trees and we would sound a note of warning about the unlimited planting of exotics, no matter how promising they may be in early youth. We are not unmindful of the introduction of larch in Britain and of the wonderful financial forecasts made, which, needless to say, were never fulfilled. The indiscriminate planting of this tree was attended with disaster to many, who were led to believe that all they had to do in order to acquire wealth was to dig holes in the ground and plant larch regardless of conditions of situation, soil and climate. New Zealand has experienced recently a boom in private afforestation and both Great Britain and India have been flooded with literature of various tree planting companies who hold out prospects of minimum returns after 20 years of £150 for every £50 now invested. This works out at a rate of 5·7 per cent. compound interest, a rate which no insurance company will pay. Besides this minimum return, estimates of yields amounting to £250 to £300 per acre at a rotation of 20 years are talked of. It will be interesting to

examine with the critical eye of the professional forester some of the figures of the prospectus of New Zealand Forests Ltd. which we have before us. The prospectus nowhere states the cost of planting but we can assume that the figure of £8 per acre at which the State plantations stand is approximately correct. This figure would be quite reasonable and open to no criticism. The estimated return per acre on a stumpage value of 5*s.* to 6*s.* per 100 superficial feet is £250 to £300 per acre and we are further told that these figures are for final yield of sawn timber only. The final yield must, therefore, be not less than 100,000 super-feet. We are not certain what is meant by super-feet, if the unit is the well-known American board feet, the corresponding cubic feet value is about 20,000 to 25,000 c. ft., at lowest 10,000 c.ft., but it is stated in a letter specially written to us on behalf of the company that the M.A.I. of such plantations in New Zealand is estimated at 250 c.ft. of wood per acre, which represents at 20 years 5,000 c.ft., or a maximum of 60,000 board feet which is a long way short of 100,000 super. feet. South African figures (Sim, Tree planting in South Africa) show M.A.I. of from 230 to 415 c.ft. Now all these figures of returns from small areas probably represent Quality I and nothing is said about the other qualities. When large blocks of hilly land are planted it is quite certain that great variations in quality will occur and it is by no means unlikely that parts of the area will be found unsuitable for the species in question. Again full stocking over thousands of acres will most certainly not be attained. No deduction on this account has been made in the financial forecast, nor for losses from fire, wind, insects and fungi. Professional foresters will realise the immense risk both from fire and disease of planting large blocks of exotic conifers. In the moist climate of New Zealand the fire hazard may not be great but the danger from insects and fungi is the greater. The conifers introduced into Britain are fast contracting one disease after another and New Zealand will be singularly fortunate if she escapes a similar fate. Even should the first rotation yield the results anticipated we are convinced that the growing of artificial crops on a short rotation under

the system of clear felling and planting can only end in disaster; in exactly the same way as the planting of spruce in Saxony has ended in disaster. All over Europe the cry is now for mixed woods and natural as opposed to artificial regeneration. We are all in favour of afforestation and *Pinus radiata* may give wonderful results, but we do not like the financial arrangements of the company. No doubt they have been very cleverly devised but if we are going to invest our money in planting trees we prefer to put it all into the business rather than to spend a considerable portion of our capital in buying single premium insurance policies and paying salaries, commissions, and other office expenses which however profitable to those concerned do nothing to help in the production of timber.

THINNINGS.

1. A very interesting article in the November number of the *Indian Forester* dealt with the advantages of thinnings in *kail (Pinus excelsa)* and *Pinus Strobus* crops. In this article it said, "The climatic conditions in the Himalayas are not so very different to those of other mountain ranges and the opponents of thinnings are in opposition to the great bulk of accepted opinion. This does not necessarily imply that their opinion is to be derided." As the working plan for the Chakrata division (the only division in these provinces with *kail* crops) is just being revised, and as we propose *not* to do thinnings, I venture to explain briefly why we are deliberately "going in opposition to the great bulk of accepted opinion."

2. The first step is to divide thinnings into two categories, (1) those which are saleable, and bring in early financial returns, (2) those which are unsaleable and involve early and fairly heavy periodically recurring expenditure.

With regard to the first category I have nothing further to say, such thinnings are done as a matter of course (and very gladly) in every forest and every species in the Province.

With regard to the second category, I imagine that every one agrees thinnings are *silviculturally* desirable, but has

"accepted opinion" ever worked out what it is going to cost financially? Taking the figures given for plots 601 and 602 in the tables printed with the article, about 650 stems per acre (average age 45 years) were felled between 1905 and 1925. At a cost of four a penny, this comes to over Rs. 10 per acre. If the rotation for *kail* is 160 years, there are still about 110 years to go, by which time at 4 per cent. compound interest this Rs. 10 will have mounted to about Rs. 750 per acre! (Not that I personally believe much in these compound interest calculations but they seem to be the "accepted opinion.") Can "accepted opinion" tell us definitely that these thinnings will add that value to our financial crop or shorten the rotation to a corresponding extent? I very much doubt it. Let us see if Professor Hawley's tables give us any help.

Table VII shows that after 20 years of thinnings, the growing stock remaining on the heavily thinned plot 601 is 2,800 c.ft. *less* than on the unthinned plot 604. How can this greatly reduced growing stock be *more* valuable? And if it is not more valuable now, how can further reductions with subsequent thinnings make it more valuable in the future? Price increment will not make it more valuable.

3. Table VIII shows that after 20 years the 148 best trees surviving in plot 601 have a mean diameter of 11·2″ while 560 trees of all sorts surviving in plot 604 have a mean diameter of 8·2″. To get a true comparison, the question one naturally asks is what is the mean diameter of the 148 largest and best trees in plot 604? Having done a good deal of sample plot measurement, I am prepared to take a small bet that for most Indian species the apparent difference of 3″ in diameter increment will be reduced to much more modest dimensions. Similarly with height growth, we must compare the thinned plot with an equal number of the *best* trees in the unthinned plot. I do not mean to suggest that there will be no difference, or even a negligible one, but is the difference going to be worth Rs. 750 per acre at maturity, or shorten the rotation sufficiently to make it worth while?

4. The article quotes 12 specific advantages of thinnings, as summarised by Professor Hawley, for areas which are obviously in category (1). Let us see how some of them apply to areas in category (2).

(1) "*The thinnings have reduced largely the number of trees per acre.*" Yes, and also the growing stock.

(4) "*The actual amount of material secured by the thinnings, is considerable*" which costs a lot of money to cut down to rot on the ground. It is cheaper to let it rot standing.

(7), (8) and (9). Financial results automatically reverse for category (2).

(10). "*The thinned plots are in more vigorous and healthier condition than unthinned plot.*" This is a strong *silvicultural* argument for thinnings in unsalable areas, but surely we are entitled to ask what it is going to cost *financially*, when such recurring expenses occur every 5 or 10 years for at least the first half of the rotation. Anyhow in the United Provinces we propose to wait until further research has answered that question, and we are quite willing to start thinnings again if research proves it is advisable financially as well as silviculturally.

It is rumoured that there is a proposal in the Punjab to make *very heavy* thinnings in deodar and *kail*, in the hope or expectation of a very considerable reduction in the rotation required to obtain a definite exploitable diameter. It would be very interesting if any concrete evidence on this point could be published. A comparison of increment of mean crop diameters in thinned and unthinned plots is no fair test (as indicated in para. 3 above), what is really required is the mean diameter of thinned plots and an equal number of the largest trees in unthinned plots, at or approaching maturity. Will the difference in length of rotation for a fixed exploitable diameter justify the cost incurred in the unsalable thinnings during the rotation? Has the Research Institute any information bearing on this question?

5. In the article a series of plots in deodar in Kulu is referred to, where "the unthinned plot was in a more or less mori-

bund condition." Well, we also have an unthinned deodar plot in the United Provinces—the Inspector-General's plot of virgin forest at Mundali, which never has been felled or thinned, and never will be. That magnificent stand literally leaves one gasping the first time it is seen.

6. Doubt regarding the financial aspect of unsalable thinnings is one point, but in the concrete case of the deodar and *kail* forests of Chakrata, there is a still more important point. During the last ten years we have thinned extensive areas of 30 to 60 year old pole crops at considerable expense and the snow has completely wasted all our efforts! I admit that if these crops had been thinned regularly and frequently from an early age, the snow damage *might* possibly not have been so bad. But the fact remains they were not thinned, and for the extensive areas that still remain unthinned, when Nature has so clearly proved that we are too late, what option have we except to stop thinning further? Emphatically we have no option in the matter.

And if we decide to leave these older crops alone, and concentrate on thinning the quite young crops 10 to 20 years old, we are impaled on the financial horn of the dilemma worse than ever. Thinnings are not utilisable in Chakrata until they supply trees of at least 14" diameter—say 100 years of thinnings that cost money to do, and reduce the stems per acre from 2,000 or so to 200. I wonder if "accepted opinion" in Europe and America would be so emphatic on the benefits of thinnings if it had to *spend* money in doing them for the whole rotation, instead of getting money for doing them.

7. There is yet another point. The money available annually for thinnings and plantations together is limited. Shall we spend some of it in thinnings that may or may not increase revenue 100 years hence, or shall we spend it all on plantations that will enable us in ten years to remove a valuable overwood which stubbornly refuses to regenerate itself naturally?

8. I must confess that I am a very new recruit to the school of "no thinnings unless salable" and only a short time ago

the unthinned *kail* crops of Chakrata were an eyesore. But now, the thinned crops-cum-snow-break are still more so. In preparing the preliminary report for the revised Chakrata plan, I was faced with a choice of two (silvicultural) evils, I thought then and think still that "no thinnings" was the lesser evil, while the financial aspect of very early and long continued unsalable thinnings could not be ignored. If there was any suspicion or evidence that an unthinned crop would in time exterminate itself, financial and other considerations would have to go by the board, and we should have to thin, but I know of no such evidence, and there is certainly nothing in the extracts from Professor Hawley's bulletin to show this. If thinnings also considerably reduced the rotation, and thereby increased the annual yield and revenue more than sufficiently to pay for the cost of thinnings, that would be a financial argument that would appeal to us. But we still await proof of this.

9. To summarise our attitude regarding thinning of *kail* and deodar crops in the United Provinces —

(1) Nature will not let us thin the older crops that have so far grown up unthinned even if we wished to do so.

(2) Before starting a long series of expensive thinnings in quite young crops, we want more evidence that such a policy is financially sound.

E. A. SMYTHIES, I.F.S.

TWO MODERN WORKING PLANS FOR CONIFEROUS FORESTS OF THE PUNJAB HIMALAYAS.

PART I.

Previous to 1911 all important coniferous forests in the Punjab were managed under the selection system. In the more remote forests deodar timber alone was salable at a profit up to about 1905, since when there has been a fair market for blue pine and a small but generally negligible market for fir. The *chir* pine forests of the outer hills being within economic range of the plains markets have been worked for many years past. An

exploitable size (24" to 30" diameter) was fixed, and the numbers of trees of and above the exploitable size to be removed in individual forests were prescribed.

In order to fix the yield the time taken for a II class tree (generally diameter 18" to 23") to pass into the I class (diameter 24" and over) was computed from ring countings. The forests were enumerated, and the total number of I class trees divided by the period required for a II class tree to become I class gave the annual yield of the division. Allowances were made according to whether the II class trees were in excess or deficit and the rate at which the I class trees were removed was accelerated or retarded accordingly (Brandis' method).

The yield was fixed conservatively and where the old trees were scattered through the forests much young growth appeared. Where the older trees formed complete high forest the selection system was sometimes modified but generally the system adopted did not pay sufficient attention to obtaining and subsequently tending the regeneration in areas felled over ; trees standing over established regeneration and trees which had ceased to put on increment were not felled merely because they were not of exploitable size, works were scattered and it was felt that insufficient attention was being paid to silviculture. In mixed forests where valuable deodar trees were scattered sparsely amongst fir and broad-leaved trees, which latter were unsalable, the deodar decreased and its place was being taken by inferior species.

All conifers in the Punjab tend to form more or less homogeneous crops where conditions are not unfavourable and where the ground is not too steep, and from 1911 onwards advantage has been taken of this tendency to divide the forests into periodic blocks with the object of localising regeneration fellings, of obtaining a better distribution of age classes and a higher proportion of valuable species. Four or five periodic blocks were formed with regeneration under a shelterwood, and a rotation of 120 to 140 years was adopted, dependent on the time required by a deodar tree to obtain exploitable dimensions.

THE CHAMBA WORKING PLAN.

The Chamba working plan (Upper Ravi forests.—Trevor 1911) is interesting as being the first plan for Punjab Himalayan forests which was based on the regeneration of a definite area in a definite time. Before dealing with the technique of the plan it is necessary to describe shortly the constitution of the forests.

The Upper Ravi forests consist of deodar *(Cedrus Deodara)*, *kail (Pinus excelsa)*, spruce *(Picea Morinda)* and silver fir *(Abies Webbiana)* generally mixed with broad-leaved trees of the usual semi-European species. The deodar sometimes forms pure woods but more often is scattered through spruce, fir and broad-leaved forests. The *kail* forms pure woods only in the drier regions, where, however, the *kail* crops usually contain a small proportion of deodar. Deodar and *kail* alone have been salable up to date.

Factors of locality.—The forests for the most part are on steep and frequently precipitous hill sides. Except on rock outcrops the soil is deep and eminently suited to tree growth, and within the deodar zone the trees are of I class quality. A few pure deodar forests occur in isolated patches between cultivation on ground of moderate slope, sometimes on old abandoned cultivation : here the soil is shallower and the quality class of the deodar varies from high II class to low I class quality. The rainfall is heavy and varies with elevation, being 49" at Chamba, altitude 3,027 feet and 86" at Dalhousie, altitude 7,083 feet. Pole woods occurring in P. B. I were to be left intact when of diameter under 18" and were not to be regenerated.

Special characteristics of the forests.—Consequent on the heavy rainfall and deep soil undergrowth is exceptionally dense except in the few pure deodar forests in the zone of cultivation referred to above; broad-leaved trees flourish and the mohru oak, the horse chestnut and other broad-leaved trees frequently attain great girth and show particularly fine growth : the fir has invaded the deodar forests and over large areas is ousting the deodar, and as the mature deodar trees are felled their place is taken by brushwood, broad-leaved species and by fir in all save localities specially suited to deodar. In numerous forests numbers

of large deodar stumps in areas now occupied by fir and broad-leaved trees attest the former extent of fine deodar forests which have degenerated in the past eighty years. This ousting of the deodar by fir, by deciduous broad-leaved trees and by undergrowth is the greatest obstacle with which the management has to contend.

Conspicuous amongst the undergrowth is the *Parrotia*, which forms a hazel-like coppice and persists in comparatively dense deodar woods and in the lower portion of the fir zone: when the cover is lightened the *Parrotia* grows apace and forms dense thickets twenty-five feet in height. It occurs principally in the deodar woods and generally appears to indicate a deep soil eminently suited to the production of deodar of high quality: deodar plantations made in the *Parrotia* areas in the past exhibit rapid growth, but have been established only at considerable cost and after repeatedly cutting back the *Parrotia* coppice. Except at lower elevations there is but little *kail* in the Bhandal, Tisa and Chamba ranges; *kail* is, however, extending on such of the lower slopes as were formerly fired for improving the grass but in which annual fires do not now take place. In the Bharmaur range the *kail* grows gregariously and *kail* is everywhere extending its province in the manner common to Kulu and the Simla Hills; but this extension of the *kail* is confined to the Bharmaur range and to comparatively small areas in other ranges where the rainfall is not too heavy.

History.—Previous to 1850 there is no recorded history. It is, however, extremely probable that deodar trees were felled in the Chamba forests in ancient days for buildings at Lahore. From 1850 to 1864 there were unrestricted fellings of deodar trees in all the most accessible areas. In 1864 the forests were leased by Government in order to prevent the complete devastation of the deodar forests.

From 1864 to 1885 fellings were restricted and from 1886 to 1910 the forests were managed under selection working plans which regulated the removal of deodar trees of over 24" in diameter.

Mixed deodar and spruce in the selection working circle, Chamba State.

The forests were returned to the Chamba State in 1913 on condition that the State should employ an Imperial Forest officer and should carry out the prescriptions of sanctioned working plans.

Mr. Trevor's working plan, 1911—27.—The supplanting of deodar by fir and broad-leaved species caused grave concern and in 1911 Mr. Trevor made a working plan for the demarcated forests.

Mr. Trevor divided the forests into two main working circles, the regular and the mixed. The regular working circle contained all the forests which could be expected to produce deodar in perpetuity forming a deodar working circle, and the *kail* forests of the Bharmaur range forming the *kail* working circle. The mixed deodar, fir and broad-leaved forests were allotted to a mixed circle.

The regular woring circle—Deodar.—The forests were divided into five periodic blocks of approximately equal area, P. B. I being confined to the Bhandal range. The area of P. B. I was 5,567 acres of which some 3,500 acres were considered to be capable of producing deodar in perpetuity. The rotation was fixed at 140 years corresponding to an exploitable diameter of 30″ at breast height.

Regeneration fellings took the form of clear fellings in gaps 10 to 20 yards square scattered throughout the whole area of the compartment. These gaps were to be extended after seven years by peripheral clear fellings, and after a further seven years shelterwood fellings were to be made throughout the belts intervening between the gaps, these belts being finally clear felled in the 28th year. This system has been mis-called the "group" system, but it bears little resemblance to the typical "group" system as practised in Europe, whereby shelterwood regeneration fellings radiate centrifugally from several distinct centres in a compartment, ultimately joining with other fellings which have commenced from adjoining centres. The woods were irregular; in pure deodar forests mature trees were either isolated amongst trees of smaller girth or occurred in small patches, and in mixed forests

deodar trees were scattered amongst other species. Pole woods occurring in P. B. I were to be left intact when of diameter under 18" and were not to be regenerated. The ground was often steep and sometimes precipitous, and both the factors of the locality and the actual constitution of the forests rendered it impossible to apply the system prescribed. The first gaps were clear felled in 1912 and 1913, but in spite of continued attempts to restock them by sowings the greater portion failed to regenerate, although a very few of the gaps now contain seedlings.

In 1916 the Inspector-General of Forests inspected the fellings and ordered that future fellings should be made according to the *principles of the shelterwood* compartment system. In 1919 and 1920 such patches of mature or semi-mature forest as could be found were felled in shelterwood regeneration fellings whereby the seed-bearers were more or less regularly spaced. The marking officer did not, however, obtain the expected yield, and although a few areas of semi-mature forests were left unfelled it is certain that he was nowhere able to find extensive areas of mature woods sufficient to justify regeneration fellings extending over a whole compartment. In 1921 felling debris was burnt and in subsequent years deodar seed was sown and germinated freely. Natural seedlings have come in profusely and in pure deodar woods the regeneration areas aggregating some 460 acres contain masses of reproduction, already established. The mother trees stand somewhat closer together than is usual elsewhere, as the marking officer evidently realised the risk of the incursion of bushes when the cover is opened unduly, and now that the seedlings are established secondary fellings are urgently required. The woods as a whole were too immature to allow of regeneration fellings being made over whole compartments. Mr. Trevor had prescribed that no compact groups of trees of diameter less than 18" should be felled, but should be allowed to form part of the future crop, and in these pole crops heavy thinnings were carried out about 1919 with excellent effect. In forests in which mature deodar is mixed with broad

leaved species and where undergrowth is dense little or no regeneration has followed the fellings of 1912 and 1913.

The mixed circle.—To the mixed working circle were allotted the mixed fir, deodar and broad-leaved woods. Mr. Trevor despaired of their regeneration by any practicable means and prescribed the removal of the mature crop deodar and *kail* 30" and over in diameter during the period together with 25 per cent. of the trees of 24" to 29" in diameter which were deteriorating. The Inspector-General of Forests took exception to the policy of harvesting the mature crop without replacement and desired that the most suitable areas should be regularly regenerated for deodar. In actual practice the yield has been more or less worked up to, although of late years some difficulty has been experienced in finding the prescribed numbers of mature trees, but artificial restocking has received little attention. The problem of maintaining a considerable proportion of deodar in these mixed forests is not easy of solution and has been made more difficult by the complete cessation of the demand for fir timber during the past five years.

The working plan is now being revised, the Kulu working plan (Trevor, 1918) being taken as a model. The Kulu plan of 1918 was a great advance on the Chamba plan of 1911. Four periodic blocks were formed of which P. B. I was to be regenerated under the shelterwood compartment system in 25 years instead of the normal 30 years as it was already in an advanced stage of regeneration. Much latitude in making regeneration fellings was left to the divisional forest officer but mother trees were usually more or less evenly spaced in the form of a shelterwood. Pole woods of 12" and upwards in girth were to be regenerated. Silviculture was emphasised and regeneration received adequate attention. The removal of mature trees outside P. B. I was not expected by the working plan officer although not absolutely prohibited.

It has, however, been found impossible to model the plan exactly on the lines of the Kulu plan and it is interesting to analyse the reasons.

Chamba working plan, 1927.—(First proposals). Three working circles were constituted :—

(*a*) The regular ;

(*b*) The selection;

(*c*) The unregulated.

The regular working circle.—To the regular working circle were allotted, as in the 1911 working plan, all forests except those on precipitous ground in which the proportion of deodar and *kail* was high. Regeneration fellings were prescribed on the lines of the shelterwood compartment system. P. B. I was reconstituted as it was necessary to avoid a large concentration of areas under regeneration at any one centre on account of the incidence of grazing and browsing which are so heavy as effectually to inhibit the formation of young woods unless closure is resorted to. The working plan officer at first calculated his yield, as in Kulu, on the volumes of trees above 12″ in diameter plus increment on the existing stock for half the period. Fellings were to go over the whole of each compartment and all crops containing trees of over 12″ in diameter were to be regenerated.

The yield was controlled by volume in P. B. I only: in P. B. II no felling of mature trees was allowed and true thinnings were prescribed : in P. B. III and IV it was permissible to cut mature trees whose removal was silviculturally advisable without volume check, and thinnings were prescribed.

It was, however, found that these prescriptions were not altogether suitable. To begin with the principal object of management is to grow deodar trees for conversion to broad gauge sleepers which necessitates a high exploitable girth: logs cannot be extracted at all and there is only a very small demand for scantlings of small cross sections, and the waste from felling trees of small size is very great indeed. As a whole the woods of P. B. I were too immature to permit of regeneration fellings extending over the whole of any compartment.

The proposed allotment to periodic blocks has been retained but the prescriptions have been revised in order to ensure the

retention of all compact groups of poles of under 18″ in diameter, with additional provisions aiming at the retention of trees somewhat over 18″ in diameter in compact pole woods when their removal would cause permanent interruption in the canopy. This greatly limits the area to be covered by regeneration fellings. A few well grown deodar trees of less than 24″ in diamter will be left over the regeneration as long as possible in order that they may put on increment.

The yield of mature timber removable on silvicultural grounds in P. B. III and IV is being assessed and the total yield of the whole working circle is being fixed after making comparisons of the yield available purely on silvicultural considerations with that based on the existing stock of mature timber. The prescribed yield will consist of the volume of all deodar and *kail* trees of 18″ and over in diameter in P. B. I together with the volume of all deodar and *kail* trees over 24″ in diameter outside P. B. I.

P. B. II will be left intact. Adequate attention is paid to the artificial restocking of forests in which there is much brushwood, and to thinnings, and with the yield properly controlled it is hoped that the forests will gradually make a somewhat closer approach to regularity without much sacrifice of immature timber. A certain amount of irregularity in the young crop is welcomed and is not considered a drawback. It is recognised that uniformity will not by any means be attained throughout P. B. I, but it is held that it is unwise to sacrifice compact fully established groups of well grown poles merely for the sake of uniformity such as is theoretically demanded under a rigid application of the shelterwood compartment system.

In areas in which there is great quantity of brushwood or where there are insufficient seed-bearers resort will be had to artificial regeneration.

No attempt can be made to force the forests to conform to a pre-conceived system of management, but the system adopted must conform to the existing state of the crops. The great drawback to the adoption of the shelterwood compartment system

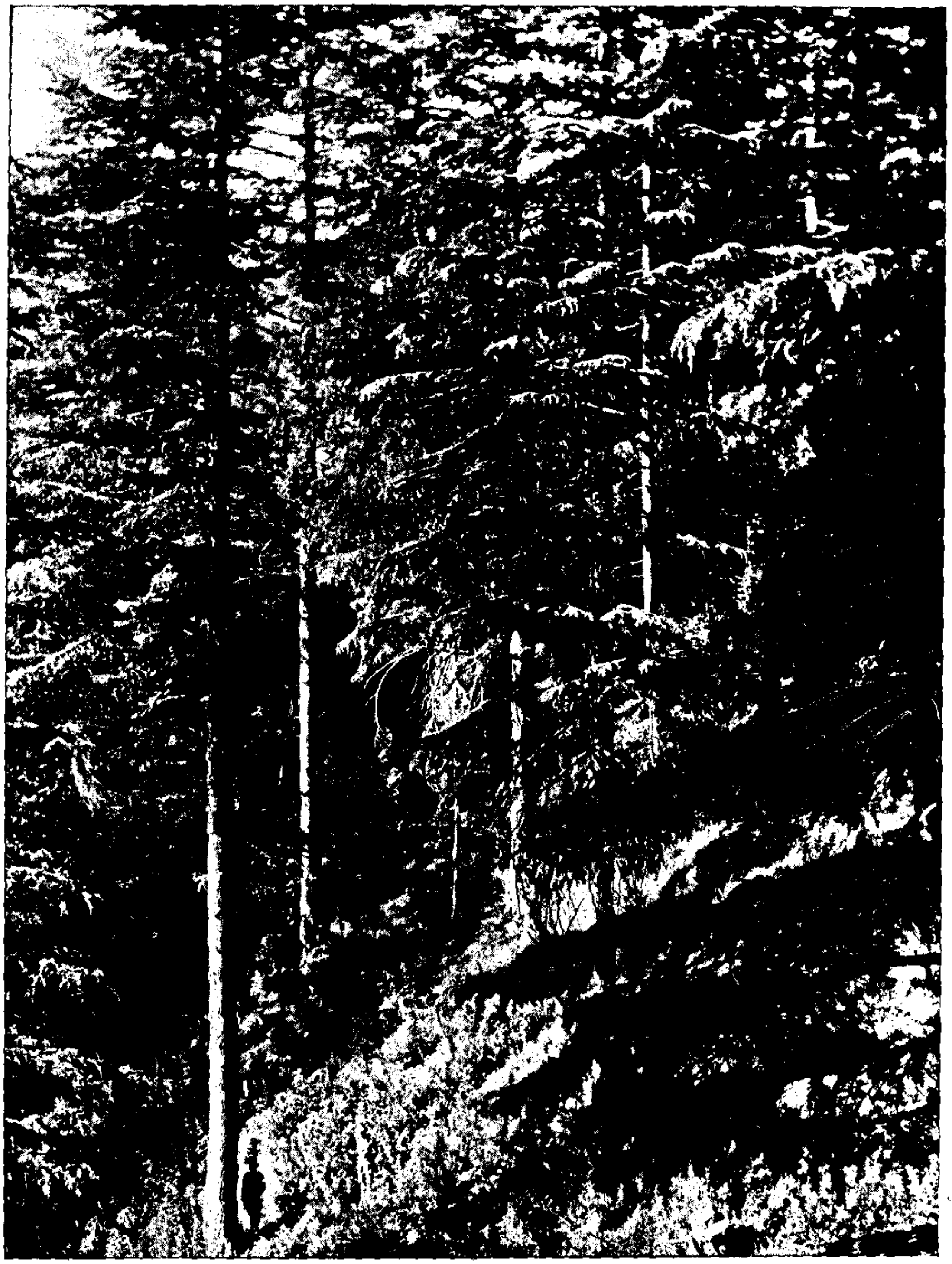
is the present irregularity of the crop: it is difficult to avoid great waste of immature material in P. B. I and to a smaller extent in P. B. II, when it in its turn will be regenerated, and there is a danger of an excess amount of mature timber being felled during the first period, if fellings of large tree theoretically out of place in P. B. III and IV, are permitted without strict volume control.

The selection circle.—The deodar is scattered through broad-leaved and fir forests. Fir timber is unsalable and there is every fear of deodar being replaced by inferior species. The rate of realisation of mature deodar has been retarded and the exploitable girth has been fixed at 30″ diameter at breast height; reliance will not be placed on natural regeneration, but selected areas will be clear felled (except for the few isolated deodar and *kail* trees which will be retained as seed-bearers) and, burnt and restocked with deodar artificially. Much of the area is not suited to deodar at all and certain plants have been noted as indicating soils suitable for deodar, which will not, however, be introduced artificially above an altitude of 7,500 feet. Among these are *Indigofera*, *Desmodium*, *Parrotia* and strawberry.

PART II.

THE MURREE-KAHUTA WORKING PLAN. (JERRAM, 1915).

We will now consider an entirely different type of forest, *viz.*, the *chir* pine (*Pinus longifolia*) forests of the Rawalpindi district which occupy the slopes of the outer Himalaya between 2,500 and 6,000 feet altitude. The underlying rocks consist of tertiary sand-stones and clays, the slopes are usually moderate and the soil is a clayey loam of low productivity. The rainfall is moderate and varies with elevation from 40 to 60 inches of which more than half falls during the monsoon; from April till the end of June little rain falls and the forests are most inflammable. There is a general absence of bushes, broad-leaved species and weeds, and many of the forests are moderately heavily grazed. On northern and eastern slopes the *chir* grows gregariously and



Shelterwood regeneration fellings of 1919 in mature deodar forest.

is of II class quality but on southern and western aspects brushwood occupies all the lower zones. In 1915 the crops were irregular but a large proportion consisted of pole forest which had originated as a result of fire protection subsequent to extensive traders' fellings shortly after the Punjab was annexed. From 1870 to 1915 the forests were worked under the selection system and in spite of numerous fires the cooler slopes were fairly well stocked with trees of all age classes.

Mr. Jerram in 1914-15 divided the pine forests into two main working circles, the regular containing all the better *chir* forests and the unregulated containing forests in which there was then no prospect of obtaining a sustained annual yield.

The writer has recently revised the working plan for the Rawalpindi East division which contains nearly three quarters of the forests, and this article is concerned only with the regular working circle of the Rawalpindi East division. Mr. Jerram carefully allotted the forests to three quality classes based on maximum height growth: he estimated the density of individual crops and employed reducing factors: to P. B. I were allotted the more mature forests aggregating one quarter of the reduced area of the whole of the pine regular working circle; it was, however, impossible to exclude all immature crops from P. B. I.

The rotation yielding a tree of exploitable dimensions (6′ 0″ girth) was fixed at 120 years, but P. B. I was to be regenerated in 25 years on account of the amount of the advance growth already present. P. B. I alone was enumerated and the yield thereof was fixed by volume by calculating the existing stock of trees of 3′ 6″ and upwards in girth together with the increment thereon for half the period less a deduction equivalent to two trees per acre on account of trees to be left as seed-bearers to restock areas which might be burnt by fire.

In P. B. III and IV the over-mature surplus stock of I class trees could be removed subject to no control by volume.

All forests which had reached the pole stage were to be burnt departmentally in the winter and rigid fire protection was

prescribed in regeneration areas. The results of the policy of departmental firing have already been treated fully in an article by the writer in the *Indian Forester* of June 1927: it will be sufficient to note here that the policy has been successful in all except forests under regeneration of which a large area was burnt in 1926 and 1927, and that it has been decided to burn departmentally in the winter all areas in which the regeneration has reached the small sapling stage in an attempt to rid the regeneration areas of grass and inflammable material in order to lessen the destruction caused by a fire during the hot weather.

Until the end of the war fellings in P. B. I resembled the old selection type fellings; fire protection was successful and by 1921 there was a fair amount of advance growth. From 1921 onwards heavy seeding fellings leaving 4 to 8 seed-bearers per acre have been made, and previous to the fires of 1926 natural regeneration was profuse and all that could be desired in all save particularly unfavourable localities.

In 1922 many of the areas allotted to P. B. I and P. B. II were interchanged in order to allow of concentration of fellings for the introduction of American methods of exploitation, and this resulted in the inclusion of more immature areas in P. B. I. Up to 1922 pole woods had been considered to be part of the regeneration but from 1922 onwards regeneration fellings have been made therein with a vast increase in wastage as the outturn was largely unsalable.

The object of regenerating pole woods in P. B. I was to obtain homogeneous crops but it has now been recognised that it is impossible and also undesirable to obtain complete regularity in the first rotation, and a certain amount of irregularity in the young crop is not only accepted but welcomed as rendering the forests more immune from the effects of fire.

Compact groups of poles of 4′ 6″ and under in girth will now be left to form part of the future crop, and no poles will be felled therein—even if they are of somewhat greater girth than 4′ 6″—should such removal give rise to a permanent interruption in the canopy. It is hoped that by this means the wastage of

immature material will be reduced and it is recognised that the young woods will be by no means so even-aged as had originally been expected. In supplementary fellings much of the mature stock in P. B. III and IV has been removed : these supplementary fellings have varied from the removal of genuinely over-mature and deteriorating trees to regeneration fellings ; notwithstanding the fact that theoretically mature trees are out of place in P. B. III and IV, it has now been decided that it is necessary to control and limit the volume of timber which can be removed outside P. B. I in the interests of the future yield.

Reallotment to periodic blocks.—It has been necessary to reconstitute P. B. I and during the remaining 13 years of the first period regeneration will be completed over 24 per cent of the area. Some forests included in P. B. I in 1922 have been relegated to P. B. II or P. B. III in order to reduce the wastage involved by realising immature stock now.

As mature woods as possible have been allotted to P. B. II, aggregating 24 per cent of the circle ; the present stock of I and II class trees, however, amounts to only 1,600 c.ft. per acre, which is low. P. B. II will be left intact during the remainder of the period apart from necessary thinnings.

P. B. III and IV contain trees which are older than they should be theoretically, but this is all to the good as the allotment to blocks other than P. B. I is provisional only and will be subject to revision at the end of the first period.

Revised calculation of the yield.—All the forests have been re-enumerated and the numbers and volumes of I class (6′ and over in girth) and II class (4′ 6″ to 5′ 11″ in girth) trees have been ascertained.

It has been found that a II class tree attains I class dimensions in 30 years and the permissible annual yield based on the existing stock alone of I class trees has been ascertained by dividing the volume of the I class trees by 30.

It has been ascertained by actual enumeration that the numbers of II class trees are far more than sufficient to replace

the existing I class trees during the next 30 years, but the realisation of the yield will not be accelerated in view of the risk of the areas under regeneration being wiped out by fire. The prescribed yield will now consist of the volume of all trees of 4′ 6″ and upwards in girth felled in P. B. I together with the volume of all trees of 6′ and upwards in girth felled outside P. B. I. A reserve of two seed-bearers per acre has been retained as fire insurance in P. B. I and only 36 per cent of the volume of the I class trees at present in P. B. III and IV will be removed. These trees are genuinely surplus stock and the yield is obtainable with ease silviculturally. The various periodic blocks have been distinguished by separate colours on range control maps. P. B. II will be thinned once in the first ten years and each forest in combined P. B. III and IV will be thinned once every ten years. Map control will be an essential feature of the management, and as thinnings are completed the areas will be painted in darker shades and the year of operation entered.

There will be no objection to thinnings being carried out more rapidly should opportunity arise and the minimum and not the maximum area to be operated in each year is prescribed.

CONCLUSION.

It has been proved in the last 16 years that regeneration can be obtained in deodar, *kail* and *chir* forests on all except very steep ground by means of shelterwood fellings, though in the case of the deodar forests much artificial work is needed to extend this valuable species. It is now recognised that it is both impossible and undesirable to attempt to obtain complete uniformity in size in the young crop throughout P. B. I and that the great sacrifice of immature material is not justified.

It is also recognised that it is necessary to prescribe the volume of timber which can be removed throughout the *whole* working circle and that it is unsafe to regulate the yield only within P. B. I and to leave the removal of trees in P. B. III and IV to the silvicultural discretion of the marking officer.

It is necessary to modify the system to be employed to the existing state of the crop and no attempt is now being made to force the forests into a pre-conceived theoretical system to which they are unsuited.

Up to 1911 the aim of working plan officers was to eke out the existing stock of trees of large dimensions in order to form a sustained annual yield until the younger age classes should attain exploitable dimensions : in recent years far greater attention has been paid to silviculture and the proper regeneration of the forests has received first attention with the result that the correct realisation of the yield based on the existing stock of mature timber has at times been overlooked. An attempt is now being made to ensure adequate attention to both objects of management; the task is by no means easy and ideas on the subject of the methods of calculating the yield and of the correct management of the forests have by no means crystallised, but it is hoped that with further experience standard methods of assessing the yield and progressive improvement in silvicultural methods will be attained.

H. M. GLOVER, I.F.S.

21st October 1927.

THE EFFECT OF SIZE ON GERMINATION AND DEVELOPMENT OF SEED OF SAL (SHOREA ROBUSTA).

It has by now been shown so many times with various tree species and in various countries, that germination of seed and early development is influenced by the size of the seed used, that it might well be considered a work of supererogation to repeat the investigation. There is however, as far as I am aware, no published example from India, or with a *Dipterocarp*, so it appeared to me to be worth while to test the general conclusions with sal.

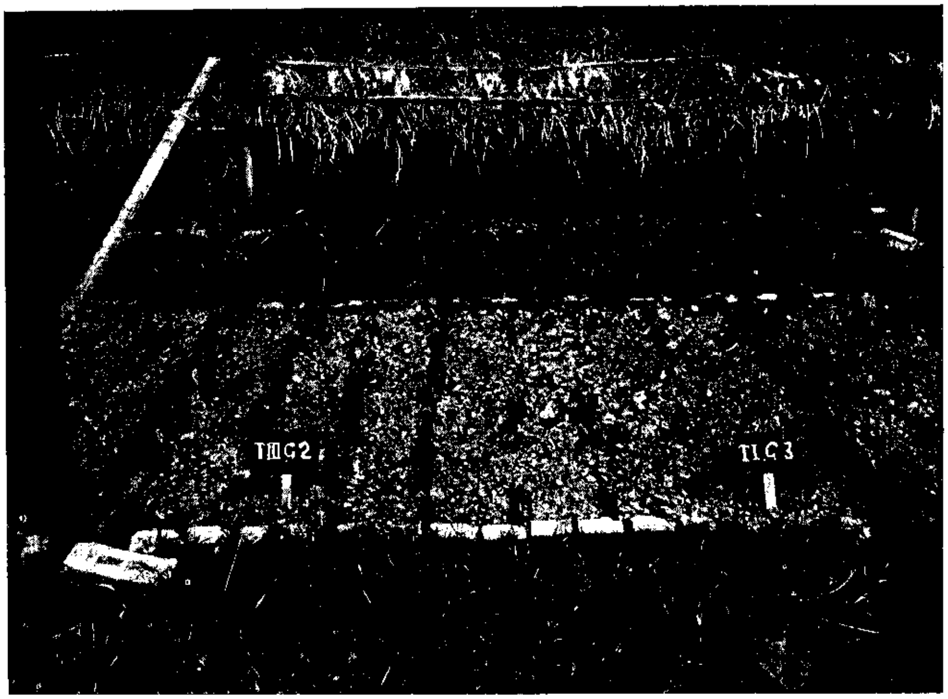
The seed used was collected separately from three different trees growing in the Dun. Each lot was graded by hand into mean diameter grades of one-twentieth of an inch, obviously defective seed being rejected but no other selection being made.

The following table shows the number, range and average for each tree :—

Tree No.	Diameter Grade.							Average diameter.	Total.
	Hundredths of an inch.							*Inches.*	*Number.*
	60-55	55-50	50-45	45-40	40-35	35-30	30-25		
	0	1	2	3	4	5	6		
	Number of seed in each grade								
I	...	181	877	317	63	...	...	·468	1,438
II	...	...	...	55	122	702	765	·308	1,644
III	4	40	66	602	107	...	...	·428	8 9

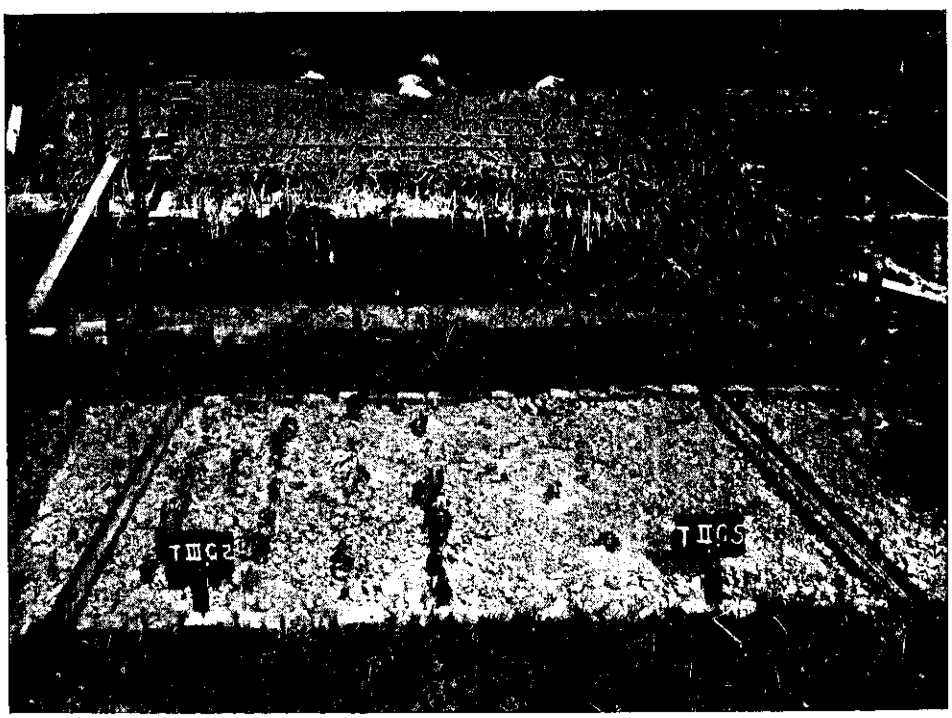
Sample lots of 50 seeds each, taken absolutely without selection from the heaps by grades and trees, were sown 4″ apart in nursery beds in lines 6″ apart, the lots being distributed with the usual precautions to eliminate as far as possible the likelihood of results being affected by chance inequality of conditions. Altogether 23 lots were sown and the odd four big seed of tree III. The beds were weeded as required. A good many leaves were lost and possibly some plants killed through their getting coated with mud splashed on to them by rain and of course an occasional plant may have injured during the weedings. At the end of rains, the weed free beds appeared to be suffering from excessive insolation and were shaded but this was done too late to affect results. Altogether of the 1,154 seeds sown 736 germinated and 562 plants were alive at the last inspection on 27th October 1927.

Germinative Capacity.—The table given at the end of the note gives the actual figures for the different lots. It will be seen that taking all three trees together, the upper half of the range shows uniform value at 75 per cent. whilst the lower half shows a pronounced falling off with size to 28 per cent. for the lowest grade. Most of the seed of the small seeded tree No. II remaining over from the nursery sowings was tested on damp sawdust. Combining the two tests out of 1,313 seed, 573 in all germinated, the figure for decreasing diameter grades being 64, 41, 49 and 31 per cent.



Comparative sowings from Sal seed graded by size.

T. III G2. 50 seed from Tree III, grade 2 (·45″—·50″).
T. I G3. 50 seed from Tree I, grade 3 (·40″—·45″).



Photos. by Har Swarup, November, 1927.

Comparative sowings from Sal seed graded by size.

T. III G2. 50 seed from Tree III, grade 2 (·45″—·50″).
T. II G5. 50 seed from Tree II, grade 5 (·30″—·35″).

Plant per cent.—The figures show a steady fall from grade to grade, small between the successive larger grades, but very pronounced for the smaller, the lowest being actually zero and the largest 75 per cent. It will be noted that though the lowest 0·25"—0·30" grade showed 28 per cent. germination, no seedling survived.

Average Height.—The same tendency is equally apparent, the average height falling from 4·0" for the top two grades to 1·6" for the lowest but one. It will be noted that average development is much behind what is obtained in adjoining *taungya* sowings, the probable reasons being suggested above; actually this was a favourable factor from the experimental point of view emphasising differences.

Vigour.—The vigour of the plant may perhaps be indicated by the number of good sized leaves formed and retained and this factor too shows a steady fall from grade to grade from an average of exactly two for the top grade and only 0·1 for each of the plants of the lowest surviving grade. This is partly compensated by a larger number of smaller leaves, but if one takes one big leaf to be as good as two small ones, the sequence is equally obvious. An optical estimate of vigour shows the same thing, 100 per cent. being normal or better in the top grade, ranging down to 16 per cent. in the lowest. *The product of the plant per cent. and the average height is probably the best indication of the final condition and value of the sowing, and the sequence 300, 268, 228, 156, 75, 30, and 0 form a very conclusive demonstration of the end result of this investigation.*

Effect of Average Size of Seed on the parent tree.—Considering seed of the same grade for different trees with different average seed size further data are desirable, but as a result of 8 tests in 3 grades, with seed from the all three trees, it is very apparent that germinative capacity, plant per cent., average height, number of big leaves,—in fact all the factors studied—are much better with seed from the tree with the higher average seed diameter; in fact the average grade for two trees being ·31" and ·45", their plant per cents bear this same proportion to each other, *i.e.*, 42 to 61. The averages of results from trees

I and III are given in the table as the average seed diameters are very close—·43″ and ·47″; these two agree very well throughout giving confidence in the results, but the low figures for tree III may possibly be influenced by some peculiarity in the tree itself rather than a direct consequence of the size of the tree; repetition is desirable and will be carried out.

Subsequent Development.—Earlier investigations show that one can expect later development of these seedlings to depend on their present condition rather than ultimate history, *i.e.*, that seedlings of a given type will, on the average, show the same progress next season whether they are the best of a poor lot or the poorest of an exceptionally good lot. They will, however, be retained for another season for checking this point.

H. G. CHAMPION, I. F. S.,
Silviculturist

TABLE.

Average Diameter for tree. Inches.	Grade No.	Diameter of seed in inches.	Germinative capacity.	Plant per cent. p.	Average Height, h. Inches.	Average No. of big leaves L.	Average No. of small leaves, l.	2L+l.	Percentage plants normal.	p×h.
...	[0*	·60—·55	75	75	4·0	2·0	1·0	5·0	100	300]
...	1	·55—·50	74	67	4·0	1·6	1·3	4·5	83	268
...	2	·50—·45	75	69	3·3	1·2	1·9	4·3	83	228
...	3	·45—·40	73	60	2·6	0·5	2·0	3·0	71	156
...	4	·40—·35	60	34	2·2	0·1	2·2	2·4	37	75
...	5	·35—·30	54	19	1·6	0·1	2·0	2·2	16	30
...	6	·30—·25	28	0	0	0	0	0	0	0
·47	2	·50—·45	71	63	3·2	1·1	1·8	4·0	82	198
·43	...	...	81	79	3·4	1·3	1·7	4·3	84	269
·45	3	·45—·40	75	61	2·7	0·7	2·0	3·4	73	165
·31	...	...	66	42	2·2	[illegible]	2·3	2·3	71	92
·45	4	·40—·35	58	44	2·3	0·2	2·3	2·7	37	101
·31	...	...	58	21	1·9	0·1	2·0	2·2	23	40

* 4 seeds only.

TWO NEW BAMBOOS FROM BURMA.

Neohouzeaua stricta, sp. nova affinis N. mekongense, A. Camus sed inflorescentia gracilior et spiculae minores.

A loosely tufted bamboo with very straight erect culms 7—9 m. long, 5 cms. diam., dark green, internodes 60—100 cms. long walls thin, nodes not prominent but marked by a sharp ledge after the fall of the culm-sheaths, young culms covered with short harsh hairs.

Culm-sheaths deciduous, about 22 cms. long, clothed on the back with brown irritating bristles and a little white powder, apex of sheath when spread flat produced on either side in broad triangular auricles which on the inner side are furnished with a row of stiff erect scabrid setae about 12 mm. long; ligule very short fringed with a row of similar but more slender setae; imperfect blade very narrowly linear-lanceolate, reflexed, about as long as the sheath. Leafy branches switchy, in dense half-whorls at the nodes.

Leaves 18—28 by 3—4 cms. or smaller, scabrid above towards the lower edge, narrowed into a long twisted scabrid point, paler or slightly pubescent beneath, margins minutely scabrid, main lateral nerves about 7 on either side of the midrib, intermediate veins 5—8; petiole 5—10 mm. long; leaf-sheath grey-pubescent when young, callus with a fringe of minute white hairs, auricles with long setae; ligule short with a fringe of slender setae.

Inflorescence a large panicle of leafless or sometimes leafy branches in dense half-whorls, rachis smooth, slender bearing the spikelets in few-flowered or dense usually closely approximate heads. Spikelets fertile and sterile mixed in about equal numbers, the former 15—16 mm. long, linear-cylindric, consisting of 3—4 small ovate mucronate glumes, increasing in size upwards, the uppermost usually bearing a very small arrested spikelet followed by a joint of the rachillus 1·5-2 mm. long, flowering glume 8—11 mm. long, convolute, many-nerved, microscopically pubescent, tipped with a mucro ½—1 mm. long, palea similar to the flowering glume 12—15 mm. long, tipped with 2 scabrid mucros 2—3 mm.

long. Stamens 6, filaments united in a tube, anthers 4 mm. long obtuse. Ovary and style glabrous, the latter as long as the palea, stigmas 3, short, plumose.

No. 2404, 2408 Tavoy district, 2462 Mergui district, coll. R. N. Parker. Along the Tenasserim river valley, common. Flowered gregariously in patches in 1925-26. In January 1927 a very few clumps were seen in flower but large numbers were not flowering. Vernacular name tapat-wa (Karen), thabut-wa (Burmese).

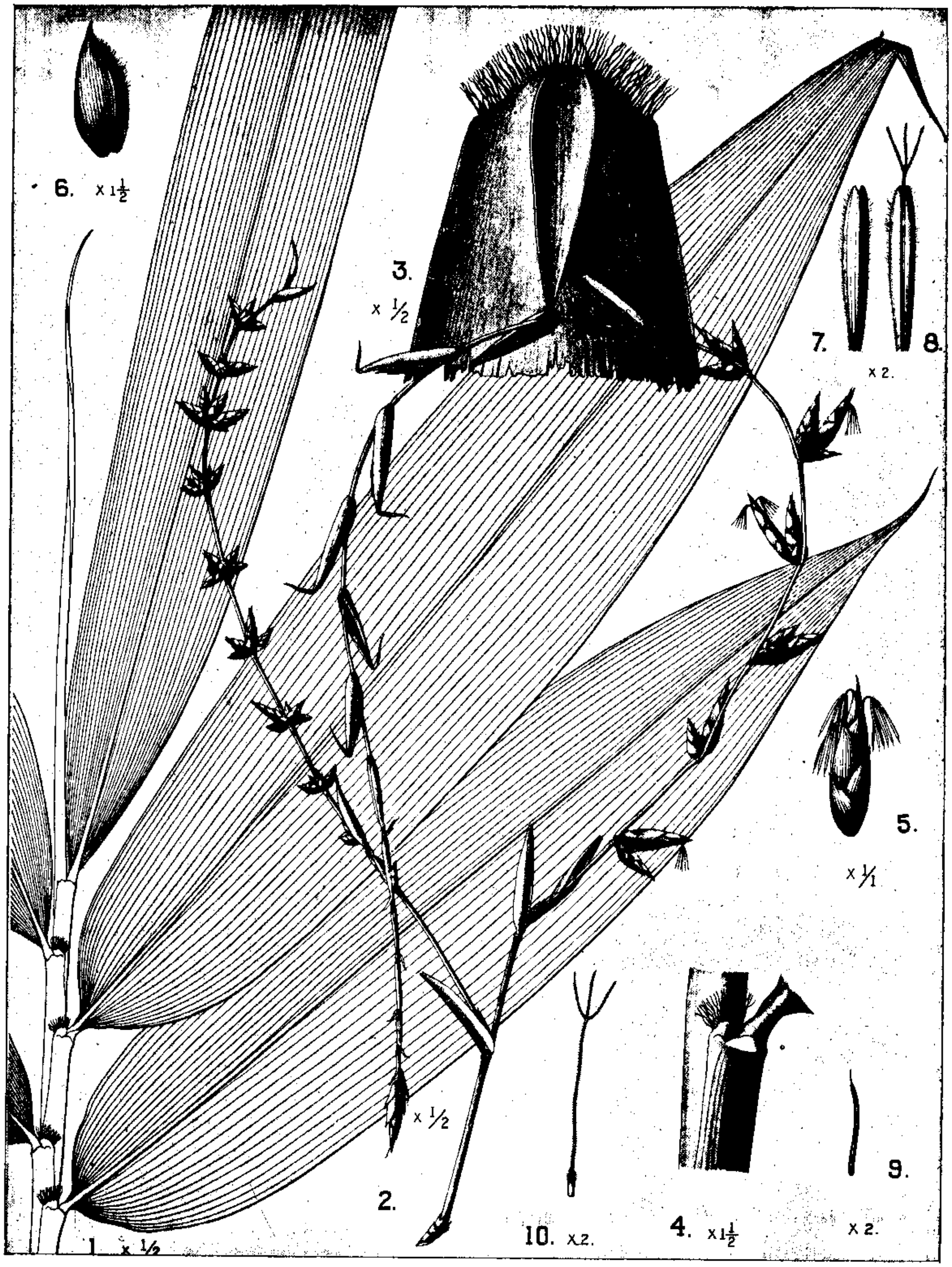
This species is undoubtedly closely allied to N. mekongensis, A. Camus. It was sent to Kew for comparison with that species but as N. mekongensis was not represented in Kew it was sent to Paris where Mlle. Camus kindly compared it with her type.

Explanation of Plate No. 9.—1. Leafy twig. 2. Flowering twig. 3. Upper part of the culm-sheath. 4. Top of leaf-sheath. 5. Spikelet. 6. Upper sterile glume. 7. Flowering glume. 8. Anther. 9. Ovary. 10. Upper portion of palea. 1, 3, 4 from No. 2452, the rest from No. 2408.

Gigantochloa compressa sp. nova, affinis G. Wrayi, Gamble, sed ligula foliorum longior et fimbriata et paleae ciliata.

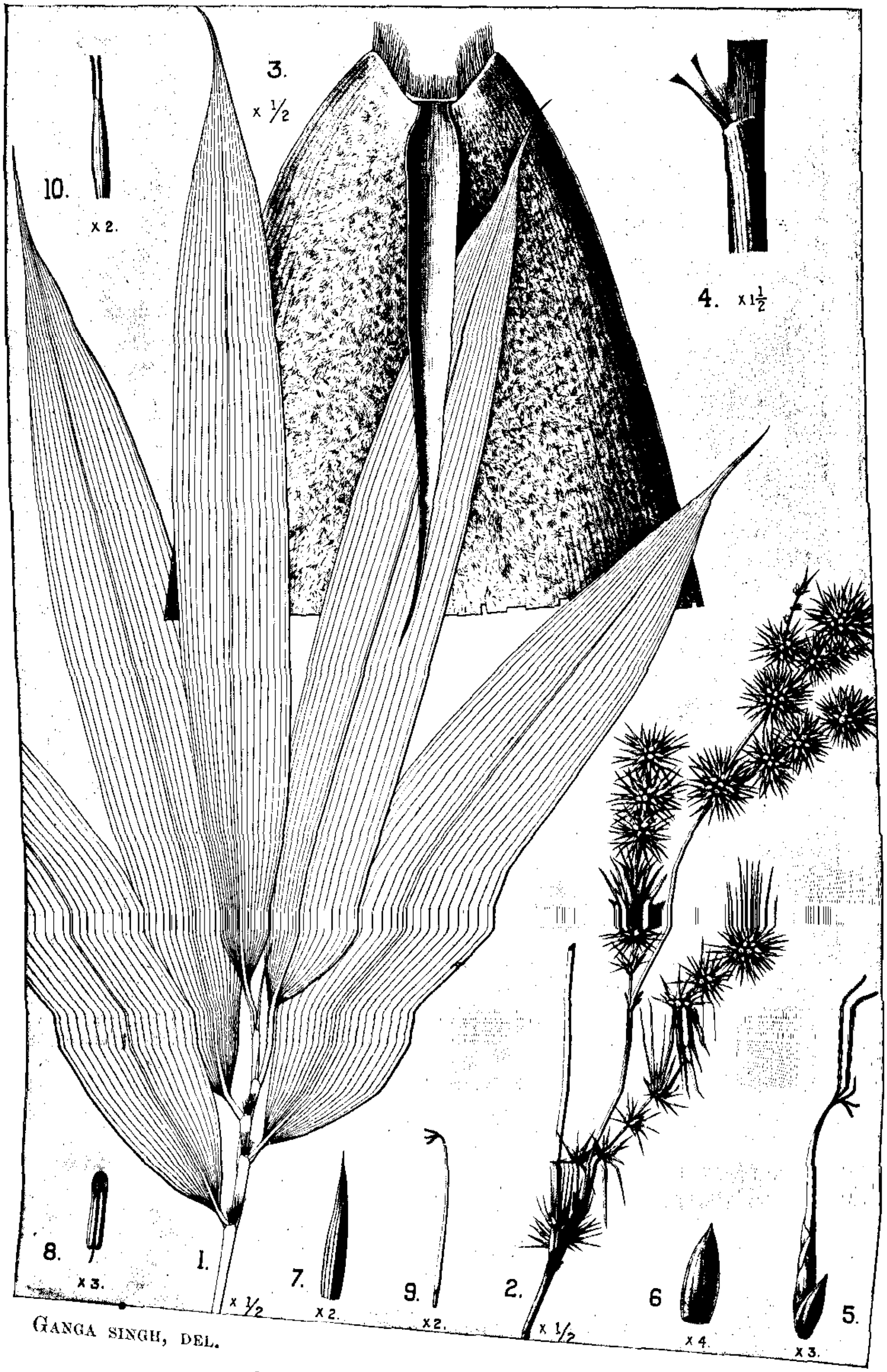
A large loosely tufted bamboo. Culms 12—18 m. long, 10 cms. diam., grey powdery when young, afterwards green, internodes—about 60 cms. long, nodes marked by a sharp ledge after the fall of the sheaths, walls about 8 mm. thick. Culm-sheath half the length of the internode, persistent, rotting on the culms, covered when young with black hairs, apex rounded with inconspicuous auricles on either side, abortive blade small, lanceolate, reflexed, ligule extending to the full width of the sheath, fringed with long white bristles.

Leaves 20—45 by 3·5—7·5 cms. glabrous above but somewhat scabrid towards the lower edge, glaucous and slightly pubescent beneath especially towards the base and along the stout yellow midrib, margins scabrid, apex narrowed into a long twisted scabrid point, main lateral nerves 7—14 on either side of the midrib, intermediate veins 7; petiole 3—5 mm. long, stout, pubescent; sheath striate grey pubescent when young and sometimes also clothed with black bristles, ending in a pubescent callus beneath the petiole



GANGA SINGH, DEL.

GIGANTOCHLOA COMPRESSA, PARKER.



GANGA SINGH, DEL.

NEOHOUZEAUA STRICTA, PARKER.

and usually two very small marginal naked calli; ligule 1—2 mm. long, fringed with white bristles.

Inflorescence a leafless or sometime leafy panicle, the spikelets arranged in discrete half-whorls of 2 or 3 fertile and several sterile spikelets in the axils of ovate or lanceolate bracts; rachis densely grey-pubescent. Fertile spikelets 20—25 mm. long, 5—6 mm. broad distinctly flattened or compressed, consisting of 3—4 broadly ovate mucronate many-nerved empty glumes which are brown microscopically pubescent or hoary and conspicuously black ciliate, followed by 2—4 fertile glumes similar to the empty but larger 15—20 mm. long and more distinctly mucronate, these followed by a glume containing an empty palea and sometimes another empty convolute glume. Paleae 15—18 mm. long, strongly keeled and ciliate on the keels the hairs grey in the lower half black towards the tip which is rounded or minutely 2-fid, 5 or 6 nerved between the keels. Lodicules O. Stamens 6—7, filaments united in a tube as long as the palea, anthers yellow or pinkish-purple 9—13 mm. long, connective produce in a hairy point about 1 mm. long. Ovary narrowly cylindric glabrous except at the top, tipped by a long slender hairy style and 3 very slender hairy stigmas.

Ngawan reserve, common on low hills, also on the Yanngwa klong, district Mergui. Parker Nos. 2624, 2629, 2633, 2641 and 2726. Flowering February and March, 1927.

No. 2751 is probably the same bamboo flowering abnormally. The spikelets are more cylindric, the paleae much reduced in size and 3—4 nerved between the keels. One spikelet although the flower below was not open contained a well-developed caryopsis 12 mm. long, cylindric glabrous, narrowed upwards and tipped with the hairy style-base. This specimen came from a clump on the side of the Yanngwa-Bokpyin road, which had been much cut about.

Explanation of Plate No. 10.—1. Leafy twig. 2. Flowering twig. 3. Upper portion of culm-sheath. 4. Leaf-ligule. 5. Spikelet. 6. Lowest flowering glume. 7, 8. Palea. 9. Anther 10. Ovary. 1, 3, 4 from No. 2641, the rest from No. 2624.

R. N. PARKER, I.F.S.

THE MANAGEMENT OF GRAZING IN THE JURA MOUNTAINS.

"It is becoming more and more apparent that excessive grazing in the hill forests is causing not merely occasional erosion of the surface soil but a steady deterioration of the forests. This deterioration is particularly noticeable in the lower hills but is apparent almost throughout the hills; it is marked by a gradual change from species which grow on moist soils, indicating a process of dessication."

In the Punjab, to which province this note taken from the most recent annual report refers we have reached a stage in forest history where the grazing incidence is more than what both pastures and forest can bear. In forests where grazing rights have been admitted it is our duty to see that an economic balance is maintained between forest and pasture; prevent forest from encroaching on pasture and *vice versa*. I had the good fortune last year to spend a fortnight studying the grazing problem in the Swiss and French Juras and a description of how forest officers are tackling the problem there, may not be without interest. It is true that in the Punjab hills we are concerned with nomadic grazing of sheep and goats while in the Juras it is cattle grazing; nevertheless, from the point of view of its control and relation to forest management I found we have much in common, at least those of us who work in the coniferous forests of the higher Himalayas.

2. The Juras are a range of lime-stone hills running almost south-west and north-east, which form a boundary between Switzerland and France. On the Swiss and south side they rise somewhat abruptly but on the French and north side in a series of plateaus. Throughout the range the cattle and cheese industry is of great importance; *e.g.*, on the pastures above the Lake of Geneva roam the cattle which provide the milk for the world-famous Nestles tinned milk and Swiss chocolate.

In both countries we find state and communal forests in which grazing rights have been forcibly expropriated by law; the Swiss and the French both realise that it is impossible to have first quality forest and first quality grazing on one and the same

area. In the Punjab deodar and pine forests Government has yet to learn this. Elaborate felling series are made so that forests can be closed or opened to grazing at various times and we show in our annual reports large areas as open to grazing but entirely miss the point that if the conifers are to be managed according to the prescriptions of the working plans there will be nothing in them for cattle to eat, however many areas are thrown up to grazing. The zamindar is not sufficiently blind to be taken in with these figures for he knows that the regenerated conifer ous forest contains merely a bed of needles. However to come back to the Juras. Besides the timber forests there is another class of forest termed pâturage boisée—literally wooded pasture. The proportion of forest to grassland varies from a few isolated trees (spruce, fir or clumps of alder) to seven or eight-tenths of the total area. They contain the village summer grazing grounds but have been demarcated as forest land and subjected to forest law because in most cases they are protective forests situated above the villages where snow and rock slides commence. The effect of the forest rules have been to increase the forest at the expense of the grass with the result that the villagers are alarmed at the deterioration of their pastures. The management of this class of forest, where an economic balance between forest and pasture is so important, has been the subject of great controversy during the last ten years and is most interesting.

3. In the first place there are many reasons why a certain amount of tree growth must be retained in these forests.

It forms definite shelter-belts against the prevailing wind and in some parts of the Juras, where the cold north-west winds are very severe and the lime-stone soil already very dry, even agriculture and fodder crops would be impossible without them. Clumps of trees growing on hummocks will not only diminish the force of wind but can shift its direction. When isolated, trees produce wide spreading branches under which cattle can rest during the heat of the day, sheltered from the direct rays of the sun. The active transpiration of their leaves increases the relative humidity and so promotes condensation and the production of dew. In seasons of drought it has often been observed that the

grass near trees is green but in the open is quite dried up for want of moisture. In spring trees help to postpone a too sudden melting of snow and so help in preventing too heavy run-off. In such circumstances tree growth has a direct bearing on the quality and quantity of grass available, acting as a sponge which can quickly soak up rain and snow but allow it to penetrate slowly into the soil and to the soil around. Again trees take some nitrogen from the air and give it to the soil which is important, as the best fodder grasses are generally those containing nitrogen. They entice birds whose droppings improve the quality of grass. Lastly in the high regions to which timber cannot easily be brought it is essential to have a supply handy for construction and repairs to chalets, drinking troughs, fuel, etc. Much fuel is used in the production of cheese. Again trees help to prevent erosion on steep or rocky areas ; they generally occupy patches of rocky or poor soil and so put to use areas which would otherwise be barren.

4. The question which naturally follows is how these trees should be arranged. Some argue that the trees should be scattered about here and there as Nature dictates while others argue that they should be definitely segregated in clumps, spinney's, etc. But from the various pastures I visited it seemed that this really depended on the locality and that no general rule could be given. In the celebrated Franches-Montagnes grazing district, where the wind is severe, the trees are scattered throughout the area either singly or in clumps, as the tranquillity of the cattle is of more importance than the actual quantity or quality of the grass. In some of the more sheltered districts north of Lake Geneva, in Canton Vand for instance, segregation is possible and undoubtedly more profitable. In the French Juras the segregation method is considered possible below 3,000 feet while the scattered method is necessary above this elevation. The Franches-Montagnes method is known as the forêt *paturee* or *prebois* (grazing forest) while the segregation type as the *paturage boise* (wooded pasture) ; terms denoting that in the former the forest dominates while in the latter the pasture. Prebois is defined as a pasture land on which trees occurring either singly

or in groups, are kept below a certain fixed proportion of the total area, generally one-seventh.

5. An example of the "segregation" method is found at Valempolieres, a commune on the first plateau of the French Juras, with an elevation of 2,000 to 3,000 feet. Soil is red clay over rock and although fairly fertile is superficial except in depressions. Private land forms 67 per cent of the commune while the remaining 1,290 acres is communal property, and consists of 464 acres of fully stocked forest, in which no grazing is allowed, and 826 acres of wooded pasture. In the wooded pastures intensive grazing in the past has caused both the pasture and the forest to deteriorate. The number of inhabitants is 265 and they possess 583 cows. These 826 acres have been divided into two working circles, one containing true grass land and the other wooded pasture land.

A.—Grass Working Circle.—To this circle has been allotted the best quality pastures which can the more easily be improved. A compartment prescribed for improvement is treated as follows :—During autumn the area is dug and then manured with a strong dose of phosphates (10 cwt. to the acre). In the next two years oats, rye-grass and clover are cultivated and in the third and fourth year the area is opened to grass cutting but not grazing. By the fifth year the area is covered with a wonderful pasture and is opened to grazing.

Besides improvements to grass, drinking troughs are constructed and groups of trees planted in suitable places, *e.g.*, on hummocks, cross-roads, to provide shelter for the cattle and give freshness to the soil. Such clumps are about 250 square yards in area.

B.—Forest Working Circle.—To this circle has been allotted the poor pastures on thin rocky soil where the association of trees and grass is necessary. Land selected for tree growth is fenced and treated as forest and is generally in spinney's of about an acre in extent. Between the spinney's grazing improves and any tree invasion is uprooted.

6. One more example, this time from Switzerland will suffice to show modern methods. Dr. Barbey, the well-known entomo-

logist, has a beautiful estate at Montcherand in Canton Vand. Forests form 46 per cent of the area and grassland 54 per cent. A working plan, with separate working circles for forest and grassland has been in force since 1902. The forests are treated under ordinary scientific methods and the grassland compartments taken up one each year under an 'improvement' cycle; the principal work being the removal of large stones, eradication of shrubs, destruction of molehills (which spoil the grass and increase the flies) and spreading of manure in a liquid condition. The total area of the grass circle is 175 acres which gives an annual yield of 98 paquieres—a paquiere being the number of areas capable of grazing one head of cattle during the annual grazing season, which here in Montcherand averages 90 days. Clumps of tree growth are carefully protected in the grass compartments whereever they are required for shelter, etc., the average growing stock being 1,120 c.ft. per acre.

7. In the Punjab hills I feel sure we must sooner or later realise that coniferous forest and grazing are impossible over the same area. A classificatlon of forests where all grazing rights must be expropriated and of forests in which a certain proportion of grassland must be maintained will be necessary, each type being managed differently. No one, who has served in the high hills, however biased he may be towards the forests themselves can fail to realise the magnificent possibilities of these fine upland pastures, which if properly managed for a rotation of cattle and sheep grazing, could support a splendid milk and mutton industry which should play a large part in the agriculture of the Province.

G. KITCHINGMAN, I.F.S.

"AN UNSUCCESSFUL EXPERIMENT."

'Twas morning, and the D. F. O.,
As was his wont, went forth to seek
An area planted up with teak.
I tell this story as I heard
It told to me not long ago.

Now his subordinate inferred
His officer would see that ground
Upon a *previous* day, but found
His careful calculation wrong!
Since the last camp move took too long,
The visit was perforce deferred.
And thus it was as I relate,
A day or two beyond the time
Arranged for, that they made the climb—
The Forester and D. F. O.,—
Upon this less auspicious date.
And to their gaze, row after row
Of teak plants moribund in death,
Amazed them, and bereft of breath
The D.F.O. could only eye
The holocaust! His wordless "Why?"
Past tongue-tied silence strove to flow.
The Forester, a wily knave,
Was tongue-tied on a different count;
For well he understood the fount
Of this amazing mystery!
He held the silence of the grave,
Confessing not the jeu d'esprit
Whereby he'd clothed the arid soil
By quite the minimum of toil,
With cuttings from surrounding trees,
The D.F.O. to gull and please!—
A *very* transient legacy.
How true it is, that though we try
To win by fickle Fortune's dice,
The best laid schemes of men and mice
Are shattered by some unseen stroke
Which makes the issue go a-wry!
The D.F.O. commenced to poke
The toe-cap of a questing boot,
Revealing what should be a root
But actually was a stem—

Now severed from the kindly phlegm
In which the woody tissues soak.
Oh, for the pen of ready scribe,
To write just how the fellow felt
When the intrigued D.F.O. knelt,
To prosecute his tactless quest
In search of Melolonthus' tribe—
That root-devouring forest pest!
In vain, for not one single grub
Was camping round each earthy stub;
Yet each dead stem which he did seize,
Left terra-firma with great ease—
In fact with quite perplexing zest!
There is an adage of some wit—
Affirming that with little pain
Some folks are ever fooled. Again—
All folks for part of time, are fooled;
But never *all* in folly sit,
By folly to be *ever* ruled!
Murder will out, with raucous din—
And so will any lesser sin.
Thus when at length Truth did transpire
No sun set on our hero's ire—
His flaming wrath could not be cooled!
'Twere best to draw a tactful veil
O'er the denouement of this plot:
Past griefs and woes are best forgot,
Since life must needs bring more...
But in conclusion of my tale—
The sinner suffered anguish sore.
For everywhere the D.F.O.
Went, he was too compelled to go
A smile on every face to rise—
A bundle of gigantic size
Of his fictitious plants he bore!

H. J. C. M.

REVIEWS.

WILD FLOWERS OF KASHMIR.

BY B. O. COVENTRY, Conservator of Forests, Punjab, Lahore. London, Messrs. Raithby, Lawrence & Co., 231, Strand; price Rs. 12, or direct from the author at Lahore.

To any one who has spent happy days amidst the alpine pastures of the Himalayas this book will bring many pleasant memories; and to those who are about to visit such happy haunts, what more agreeable companion could they take than this charming book; in which the beautiful flora of this part of the world is illustrated by means of the author's coloured photographs.

This is the second volume of this work produced by Mr. Coventry. We bought the first in remembrance of the days of our youth when our life was cast amidst such surroundings, and the second has added to our pleasure. The frontispiece to this volume of 50 coloured plates shows *Primula nivalis* in its natural

surroundings on the banks of a glacier stream at 13,000 ft. and amongst the plants illustrated we find such old friends as *Clematis montana*, the dwarf rhododendrons, *Anthopogon* and *Lepidotum*, *Pedicularis*, the louseworts, *Gentiana Kurroo* and *Fritillaria Roylei*. But apart from botanical interest the photographer will find much to admire in Mr. Coventry's treatment of his subject and his technique in the art of coloured photography.

The book contains a list of the medicinal plants, shrubs, climbers, aquatic and rock plants which are illustrated and also a classified index by Natural Orders. For those who are beginners in botany a list of botanical terms with their explanation is given and the botanical descriptions of the plants are clear and well arranged.

There must be many whose pleasure in life would be increased by a knowledge of these beautiful plants and our best advice to them is to send to the author for a copy and forthwith to improve their acquaintance with such charming friends.

COMMERCIAL TIMBERS OF THE MALAY PENINSULA.

By F. W. Foxworthy. Price $ 5 or 12*s*. No. 3 Malayan Forest Records, obtainable from the Conservator of Forests, F.M.S., Kuala Lumpur.

This publication reflects much credit on its author, the Forest Research Officer of the Federated Malay States and Strait Settlements and also on Messrs. Fraser and Neave of Singapore the printers who have produced a class of book very superior to the ordinary production of a Government Press in India. Mr. Foxworthy sets out to give an account and description of the more important timber trees of the Peninsula which are at present very imperfectly known, more especially with the view of their proper identification in the field by Forest Officers. The book is full of the most beautiful illustrations both of trees and botanical specimens and we marvel at the moderate price charged when we have had to pay Rs. 16 for an Indian working plan of very moderate size containing no illustrations and printed on common aper.

The natural feeling of a newly arrived Forest Officer in Malay in entering the forest with its strangeness and complexity is one of bewilderment. There are about 2,500 known species of trees and the inland forest is arranged in several storeys in accordance with Schimper's description of rain forest in his "Plant Geography." The first or top storey is made up of very large trees composed to a great extent of members of the *Dipterocarpaceæ* which family predominates in Malay as in the Philippine Islands. These require full light at maturity. The second storey is made up of trees which spread out at about 50 ft. from the ground; the third storey of still smaller trees; there is a fourth storey containing large numbers of the families *Anonaceæ*, *Euphorbiaceæ* and *Flacourtiaceæ* and finally the ground is covered with a profuse undergrowth of shrubs, herbs and stemless palms.

This book should be useful to all forest officers working in tropical evergreen forests, especially to those who are interested in the dipterocarps, and we congratulate the conservator, the author, and the printers, on having made public valuable information in a most attractive form.

THE DOG IN INDIA.

BY I. ALSTON. Oxford University Press, Bombay,
Price Rs. 2-8-0.

Many forest officers, most of whom keep dogs of one sort or another will like to have this small book which can live in the office box and be referred to whenever necessary. It deals with the various ailments of the dog such as distemper, mange, exema, worms, canker of the ear and rabies. We have never possessed a book on dogs but would often have been glad to have one especially when our dogs have been ill with distemper. The author knows his subject and our advice to those of our readers who keep dogs is to get a copy. At the same time we feel it our duty to bring the work of the Field Distemper Enquiry to the notice of our readers. This enquiry has already accomplished something but further financial support is necessary if the work is to be brought to a successful conclusion. Subscriptions sent to the Honorary Secretary, Indian Kennel Association, Dehra Dun, or to Lt.-Col. A. J. Williams, R.A.V.C., Headquarters Northern Command, Rawalpindi, will be gratefully acknowledged.

EXTRACTS.

APPOINTMENT IN THE FOREST SERVICE OF BURMA.

Applications are invited from candidates for eight appointments to the Forest Service of Burma, selection for which will be made in April, 1928. Candidates must be between 17 and 20 years of age and must be qualified for admission to the University of Oxford. Selected candidates will be required to undergo a three years' course of training in Forestry at that University, beginning in October, 1928, and if finally successful, to proceed to Burma in the autumn of 1931. Full particulars of these appointments are obtainable on application, which may be made by postcard, to the Secretary to the High Commissioner for India, General Department, 42, Grosvenor Gardens, London, S.W. I. Last date for receipt of applications 7th April, 1928.

(*The Times, 26th November 1927.*)

SUSTAINED YIELD MANAGEMENT FOR PHILIPPINE FORESTS.

(BY ANTONIO P. RACELIS, Forester, Bureau of Forestry.)

The forests of the Philippines are managed in such a way that the system used is necessarily broad and rough in character. It is based upon general policies rather than upon rigid adherence to any scheme of regulation. Considerable information must be secured concerning these forests before any definite plan of management can be worked out. The forests are complex in character and made up of different types, many of which have not been studied in detail. The necessary data on growth and yield are not as yet available. It can, therefore, be said that regulation of the European type or even of the American type cannot, as yet, be put into practice until such time as we have worked over our forests into a more or less normal distribution of age classes or until after comprehensive growth and yield figures have been secured. Besides this, there is the difficulty of administration due to lack of sufficient competent personnel and the social and industrial conditions

encountered, all of which are a decided drawback in regulating our forests.

Several studies have been made in the forests of the Philippines as a preliminary to forest management, some of which are the work of the early American foresters, but considerable was on paper only and never put into actual practice. Some of this work reveals the types of forests existing in the Philippines. Broadly speaking they are :—

The dipterocarps, the molave, the pine, the mangrove swamps the beach and the mossy forest types.

Of these, the dipterocarp is the most important. The importance of this type of forests lies in the fact that it covers 75 per cent of the virgin forest area of the Philippines and contains approximately 95 per cent of the standing timber. The dipterocarp forests produce soft and medium hardwoods in addition to some hard and heavy species. The time-honoured impression that the Philippines do not produce softwoods is a thing of the past. This is proven by the fact that the timber cut in the Philippines during the past few years shows an ever increasing demand for these species. Our attention should, therefore, centre on it, because it is difficult to reproduce the area with the same species once it is logged off, for it has been found that the cutting in dipterocarp forests disturbs the main canopy of the forests by developing second and third storey trees and by encouraging other species which are in the main of little commercial value.

The problem is not so much concerned with the other types of forests, as experiment has shown that timber species other than dipterocarps can be reproduced with some simple silvicultural practice. But with our dipterocarp species, the problem is different and needs a well-drawn plan of management.

The forests of the Philippines are managed under the license system with some diameter limit restriction.

In case of small investors, licenses are granted for a term of one year. The licensees are given definite forest areas where to cut and how much to cut. The diameter limit fixed for 1st group timber is 60 centimeters; for 2nd group, 40 cm., and for 3rd and lower groups generally no restriction except in more intensively regulated areas. Licenses are generally renewed at expiration.

They are subject to such limitations and regulations as will protect the forests from undercutting and over-cutting. While the system of diameter limit is not regulation ; it is, however, an effort to preserve the forest from immediate devastation. As a method of regulating the cut, it is unwise to use this system for the reason that it is based up on the wrong assumption that diameter and age are proportional and on current growth in diameter of single trees but with a volume unit for yield instead of the number of trees. Another difficulty is the uncertainty regarding the number of trees which pass from one diameter class to another. Silviculture also condemns any rigid application of diameter limit. However, in our tropical forests where the selection system is the method of treatment, diameter limit will do for the time being, in the absence of a sound and correct system of management.

Before we go any further, it is necessary that the present diameter limits be revised, based on a thorough study of the volume and species distribution of the forests and of the approximate size at which most of the principal species come into full seed bearing and maturity. With this information at hand, it would be possible to set a diameter limit for each of the species in the stand which would be satisfactory for certain types of forest. Due to lack of accurate information the diameter limit is adopted as a preventive.

In the case of lumber concessions, the areas which have to be dealt with are necessarily the dipterocarp forests. Those forests have a dense canopy, a density unequalled by any other kind of forest in the Philippines. They also have a heavy stand of over-mature and mature timber, a great percentage of which are defective, their growth and decay almost exactly balanced and their canopy and volume concentrated in the largest size classes. Aside from this, the presence of a large number of under-storey trees is in itself a problem. The dipterocarp forests as a general rule present a difficult problem of management. At any rate, as an attempt at regulation, various methods have been tried in dipterocarp areas held by these companies in order to safeguard the forests. One of them is the cutting to a 50-centimeter diameter limit. Later, the clear cutting system with scattered seed trees, as a method of treatment, has been adopted, and the lumber companies were allowed to practice it with little restriction. While this system

offers a decided advantage to the capitalists, yet the fact that it leaves the area practically barren after logging and the fact that the areas where it is practiced are not discriminated against, make the system entirely inadequate for adoption. This is not sound for it does not settle the question of regulation. It is, therefore, clear that there must be a method of treatment which will in a measure solve the problem of managing our dipterocarp forests, one which will take care of the silvicultural requirements.

In these dipterocarp forests, before any system of regulation is put into practice, it is necessary to appraise first of all the right use of the land, whether it is absolute forest land or one which is potentially agricultural. This distinction is made in view of the fact that lumber concessions have to invest a big amount of capital, in which case the location of the cut should be more or less correctly determined so that it will not occasion a financial loss to the company and in order that the land is put to judicious use.

Inasmuch as the dipterocarp forests require large lumbering operations with steam appliances, which necessitate a big outlay of capital, it is necessary that we should be considerate in the way we deal with the investors. They have come from outside, primarily to help to develop our natural resources, and for this reason we have to grant them reasonable concessions. At the same time our forests and forest lands which are the property of the State must be absolutely safeguarded. And to repeat what Forester Greely once said,—"the public has the right, provided it is reasonably and equitably exercised, to see to it that forest land is kept productive. It cannot compel private citizens to own forest land, but it can require that those who choose to own it shall use it for growing timber. The public cannot compel the logger to retain his cut-over land and become a timber grower, but it can require him to leave the land, when he removes its chief element of value, in productive rather than in a barren condition."

In view of this consideration, it is necessary to know just what the method of treatment will be. The method to be adopted in our dipterocarp forests should be based:—

First.—Upon the condition of the forests whether or not the stand is heavy; the volume distribution by size

classes, satisfactory; and the composition of the forest complex.

Second.—Upon the right use of the land, whether a tract of, forest is absolute forest land or one which is potentially agricultural.

On potentially agricultural land with a heavy stand of timber having an unsatisfactory volume distribution of size classes and less complex composition, the method of treatment which seemed to have worked out fairly well is the clear cut system with some sort of restriction. On absolute forest land, however, this system should not be practised even if the condition of the forest so warrants because the area, for a certain reason or other, may not secure proper reproduction. In this case either the selection system with diameter limits or the shelterwood system with timber marking should be used. The selection system for a lumber concession is out of the question because it will increase considerably the cost of logging. The shelterwood system which carries with it the system of timber marking, however, is the most feasible at present. It has proved some years ago, but now already abandoned, to be fairly satisfactory both to the capitalists and to the government. The only problem here is the lack of competent men to handle timber marking efficiently. But this is not serious enough so as to deter us from adopting the system.

The contention of the lumber companies that it will be difficult for them to accept methods of treatment which they believe to be a liability to their business, is not quite legitimate. The reason why such methods are hardly a liability is that these companies are more or less maintaining a low efficiency in manufacture by having too much unnecessary waste and are having excessive mill capacity. These factors affect a great deal the lumber business. The cost of logging is only part of the expenses and the loss, if any, cannot be attributed wholly to it. If they will only increase their business efficiency, it is believed it will more than compensate the so-called loss.

If there is, however, no other method of treatment and scheme of management which may be applied at a profit to the forests held by lumber concessions, there should be a compromise

between the company and the government based on the basic policy of regulating the cut and on some silvicultural requirements.

In conclusion, it may be said that in spite of the attempt at regulating the cut of the forests of the Philippines, we are not at all certain whether or not we can keep our forests for ever in a productive condition.

In view, therefore, of the manner in which we have treated our forest resources, the time has come for us to practice sustained yield management. By sustained yield management is meant the production of the largest timber crop possible so that a continuous supply may be assured.

Before starting, however, a scientific land classification should be made in order to determine the agricultural and forest values of the land. The Bureau of Forestry has already started this work, but it should be carried out on a more intensive and scientific basis. Once this is done, the government should have absolute control over these classified forest lands. Government control over these classified forests and forest lands is necessary for the practice of forestry. The question may be raised, however, whether in practising forestry the cut should be made according to the principle of a sustained yield or whether economic conditions and considerations shall be the criteria. "To be or not to be; that is the question." But it is maintained that sustained yield management should be started at the earliest possible date. To tarry any longer is to place our forests in a dangerous position because every day of delay means sc many trees cut and felled, perhaps never to be replaced.

The lack of a sound and correct system of management has had some appalling effects not only upon the capital stock of the forests, but also upon the vitality of the nation. This may be strong language, but it is true. It has turned vast tracts of forests into barren lands and made some progressive agricultural communities poor or relatively poor. No figures can be given to qualify these statements but statistics show that it is a fact. Forester Zon of the United States Forest Service, an eminent American Forester, wisely says that "if we are to allow our forests to be turned into desert and then expect to reclaim them by planting, the chances for havin any

forest at all are very slim indeed." And Zon is right. Forester Zon had exactly in mind what other foresters profess; that planting is an expensive proposition. Therefore, if we want to keep our forests forever in a productive condition, we must practice forestry; or in other words, we must regulate the cut both in amount and in location by some simple, workable and acceptable method of management. Of course, sustained yield management has certain limitations and while its principle is sound and correct, it may not be practicable here at present. But it is emphatically said that considering the fact that it is the only system which will ultimately place our forest resources on a stable and productive condition and which will at the same time yield, according to Forester Woolsey, the best results and give the best and safest investment, it is, therefore, deemed the part of wisdom to adopt at the earliest possible date the system of sustained yield management.—[*The Makiling Echo, Vol. VI, No. 2, April 1927.*]

NEW ZEALAND TIMBER SITUATION.

It may not be generally known that with the exception of farming, the timber industry of New Zealand is by far the largest employing and wage distributing industry of that Dominion. The amount of land used by registered companies alone in the statistical year 1924-25 totalled nearly £3,500,000, and the actual number of employees engaged in the industry in 1925 exceeded 10,000. A national forest inventory taken in 1923 estimated the total quantity of milling timber in New Zealand at 62,065,600,000 ft. while the output of timber for the year 1923-24 totalled only 317,069,216 ft. Apparently at the present rate of consumption, the forest stocks of the Dominion will last for something like 200 years, but the 1925 annual report of the State Forest Service points out that the softwood resources will be economically exhausted by the period 1965—70, which would give ample time for reproduction and replacement of the timber resources, and, if desirable, for increasing them.

Criticising statements that have been recently made in the Auckland district to the effect that the timber resources of New Zealand are "rapidly petering out," Mr. J. Butler of the Kauri

Timber Co., also points out in the *Auckland Chamber of Commerce Journal* that towards the end of 1926 offers had been made for the sale of two timber propositions, one relating to 1,600,000,000 ft. in North Island, and the other to 800,000,000 ft. in South Island. In addition, there has recently been several minor offers all claiming to have special advantages as to accessibility. Discussing the exploitation of the present resources, Mr. Butler points out that a tree having grown to maturity is at its highest commercial value, and should be put to an economical use as early as possible. Further, a tree can only be once used, hence the sooner it is used the sooner it assumes an active utility. It should also be mentioned that the progressive State Forest Service of the Dominion has now been able to reduce the cost of tree planting to £2 per acre, while the seeding operation has been reduced to the low level of £1 per acre. This means that hundreds of thousands of acres of land, otherwise unprofitable, are brought within the economic range of the tree-planter, State or private. After a recent visit to Australia, the Director of the New Zealand State Forest Service has expressed the opinion that the Dominion was without question the better tree-growing country, and he felt sure the day would come when the major timber requirements of Australia would be easily satisfied from New Zealand's planted forests. It is of interest to add that among New Zealand's present resources is the giant kauri tree, which is reputed to be the world's largest timber yielder and the bole of which rises to a great height without any appreciable taper.—[*The Timber News, No. 1771*]

SAP-STAIN IN LUMBER.

A most interesting discussion of sap-stain and decay in Pacific and North-West lumber has been prepared in the interest of American exporters and foreign buyers of timber by Dr. J. S. Boyce, Pathologist, United States Department of Agriculture, a report of which appears in the *Columbia Port Digest*. Although a tree might be completely sound when felled, the logs and lumber are continuously exposed to stain and decay, although, in the main, by different fungi from those that attack living trees. It

is obvious, therefore, that to avoid serious losses logs and lumber must be properly handled.

There are two principal causes of sap-stain in lumber, *viz.* chemical action and fungi. Sapwood is rich in organic compounds and also contains certain soluble ferments, which facilitate the oxidation of such compounds. Under favourable temperature conditions and when green sapwood is exposed to the oxygen of the air, these ferments, known as oxidising enzymes, act on the organic compounds in the sapwood. The result of this action, which is an oxidation process, is a discolouration of the sapwood. Hot, humid weather is most favourable for this staining, while cool, dry weather, retards it or prevents it altogether. Logs immersed in water are not affected. Hardwoods are most subject to sap-stain of this character. The stain may be superficial or extend entirely through the board, but in either case the wood is not weakened, but only rendered unsightly.

The more common and economically important sap-stains are caused by fungi, which live on the substance contained in the various cells of the wood. While this form of stain does not reduce the strength of the wood for practical purposes, it must be remembered that the conditions which promote the development of the fungus discolouration, are highly favourable to the true wood-destroying fungi. The climate of the Pacific North-West is usually quite favourable for the development of sap-staining and wood-destroying fungi during the spring and summer months, when the humidity of the air is relatively high.

Control and Prevention.—The most important and best known stain is blue stain, which may be found on almost any hardwood or softwood, and it is upon this that most of the methods of prevention and control have been concentrated. The greatest danger of staining occurs during the process of drying the rough lumber as it comes from the saw, and the best method of preventing blue stain is by kiln-drying. If air-drying only is possible, the lumber must be open-piled to permit a free circulation of air around the pieces and the piles should be roofed so that rain will run off and not drip through the piles. Lumber close-piled is particularly subject to the stain. In connection with air-drying, treatment with an antiseptic solution is of value.

Shipping green lumber close-piled in closed railway cars during the spring and summer months is almost certain to result in severe staining. Indeed, stock handled in this way has been known to stain even in winter. Shipping green lumber in the hold of a vessel, particularly, if tropical seas are to be traversed, is an invitation to swift and sure disaster as far as sap-staining is concerned. It is doubtful whether dipping in any chemical solution now used, except possibly mercuric chloride, would be effective under such severe conditions. Even dry stock in the holds of vessels for protracted periods may stain. Warm, moist air comes in contact with the cooler lumber, causing a condensation of moisture, which, if heavy enough, will raise the moisture content of the wood sufficiently for the growth of staining organisms.

Decay in Storage Yards.—All conditions which favour sap-stains are equally favourable to wood-destroying fungi. Furthermore, the latter can attack wood with a low moisture content, so the fact that wood does not sap-stain is no indication that fungi causing decay may not be present. The discolouration caused by the latter in sap-wood are not so pronounced as sap-stain; consequently they are much harder to detect. Dry lumber will not decay. The most efficient method to prevent decay is to air-dry or kiln-dry lumber immediately and then keep it dry by proper methods of storage. Placing dry lumber in the open exposed to rain, or in damp-sheds, cannot be too strongly condemned. If the lumber becomes moist again, it is just as liable to decay as before. Kiln drying is much better than air-drying, since the high temperatures employed in the former process are usually fatal to decay-producing fungi, while under the latter conditions the fungi may merely remain dormant until suitable moisture conditions are again restored. However, since wood-destroying fungi are common around and in storage yards and wood-working factories, the chances are that kiln-dried lumber will be reinfected and if it becomes moist again decay will begin.

Durability.—Resistance to decay, or as it is termed, "durability" is a variable factor. Within any species durability increases with the increase in specific gravity or weight of the wood. That

is to say, a heavy, strong piece of Douglas fir would decay more slowly than a light, weak piece. It is also well known that different species vary widely in their durability. Sitka spruce, Western hemlock, the true balsam firs, and Western yellow pine are not at all durable. Douglas fir is fairly durable, while Western red cedar, and above all Port Orford cedar, are extremely resistant to decay. Sapwood of any species rots quickly. Discrimination should be exercised in the use of woods under conditions favourable for decay, while it is equally unwise to use Western red or Port Orford cedar where a combination of durability and great strength is required, as for example, in bridge timbers or railroad ties. The cedars are not strong woods. In such a situation, Douglas fir, combining as it does fair durability with high strength, should be the choice. Where durability alone is to be considered, the cedars are unequalled. As timber becomes more valuable, all species except those of very high resistance to decay such as cedars, will be pressure-treated with a preservative before being used in situations where durability must be considered.—[*The Timber News, No. 1771.*]

THE TREES OF CORSICA.

(BY ALFRED C. AMOORE.)

A tour through Corsica, an island still but little known to Englishmen, is full of interest to students of forestry and to those engaged in the timber trade, for the variety of trees to be seen is great and their growth worthy of study. Some impressions seen through the eyes of the student of silviculture, and gathered from a completed journey through the island, may be acceptable to the readers of the *Timber News*.

Ajaccio, the beautifully situated capital, on the south western side of the island, presents quite a southern appearance by reason of the palms which grow freely in the streets, and this effect is heightened by the abundance of the prickly pear on the surrounding hill sides. The suggestion of a southern clime in some other parts of the country is heightened by the presence of eucalyptus, planted for reasons of health on low-lying ground liable to malaria, and the avenues of these tall, stately trees, almost bark-

less and with their long, drooping, grey-green leaves, make most picturesque features in the landscape. Yet another reminder that Corsica is a southern land is afforded by the abundance of olive trees and by the presence of the cork oak, of which there are large numbers in the south of the island; I saw also a big grove of the latter near Bastia, on the North East Coast. The holm oak grows very freely, and I noticed it in particular in the hinterland of Ajaccio and in the extreme north, but the trees are for the most part small. Oaks of the kind so common in England are hardly to be seen.

A tree that grows with remarkable profusion almost all through Corsica is the sweet chestnut, which flourishes even at a considerable elevation, and the nuts are an important item in the food of the peasantry, being ground up into flour. There is hardly a horse chestnut to be found. Walnuts are met with but they are not a free growth. The robinia abounds in all parts of the land and so does the plane except on the higher hills, the latter tree being planted for its shade-giving qualities.

Firs and pines grow splendidly on the higher ground, clothing many hill-sides, and beautiful specimens are to be found in the forests near Evisa, Vezzania and Vizzavona. These were being freely felled for export. In the same localities are some fine beeches. In the woods at the last named place are a few hollies, the only ones I noticed on the island; and the only limes I observed were there also, in the form of an avenue along the main road. Fig trees abound in most parts of Corsica, and cherries and lemons are occasionally to be met with. The arbutus grows and fruits lavishly and the pepper tree (not the variety used for commerce) may be seen from time to time. The cypress, so conspicuous a feature of the landscape in southern France, is not general in Corsica, and, where found, is usually round the little mausoleums which are freely dotted all over the country-side.

Corsica offers attractions to the visitor in the form of splendid mountain scenery, with roads winding round the precipitous hill-sides, which are sometimes tree-clad, but more often bare and wild and grand, with giant crags towering for hundreds of feet into the air or dropping with dizzy steepness into the blue sea or the valleys far below.—[*The Timber News.*]

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PLANTING COSTS.

What is the justifiable expenditure on planting an acre with a certain species. This is a question which frequently arises in Forestry and which is often difficult to answer. Planting enthusiasts are sometimes apt to forget the finance of planting in advocating extensive schemes of afforestation; and the pessimist is always handy to declare that planting does not pay. Our answer is another question; is it better to leave a wilderness behind one or to spend a small part of the sale proceeds of the crop in restoring the area to productivity? The fallacies of compound interest are mustered to the support of the pessimist who will lay down with the utmost satisfaction that every rupee spent on a plantation now at 4 per cent. compound interest will amount at the end of 120 years to Rs. 110 and that it is probably wiser and more profitable for the private owner or the State to bank the money and let it accumulate at compound interest *rather than to invest it in the business of growing trees* If the private owner follows the advice of the pessimist he will clear fell his timber at the earliest possible date and leave his land derelict, and the State will similarly devastate its forests until it has no forest revenue left. The people will then have nc timber wherewith to build their houses nor firewood to cook their food—a state of affairs which is by no means uncommon in certain parts of the world. Now the investment of money at compound interest for a long term of years is by no means an easy matter. We believe that no bank will take money at compound interest for 100 years; insurance companies might be

induced to do so but the rate of interest offered would be low. What both the State and the individual do with their revenues is to spend them, wisely or otherwise. The State has no reserve funds but rather loans and the private individual frequently lives on an overdraft. What they both require is *income* either to pay their way or the interest on their debts. Our point of view is that in the case of existing forests the cost of replacing a felled crop—whether naturally or artificially should be charged against the gross sale value and should not be compounded for the length of the rotation. For instance the final yield of an acre of deodar, middle quality, is 10,750 c.ft., deduct 10 per cent. for converting standard to commercial volume; 55 per cent. of the latter volume for loss in conversion; leaving 4,350 c.ft. of sawn timber; add 10 per cent. for yield from thinnings and a gross yield of 4,785 c.ft. of converted timber is obtained with a stumpage value of Re. 1 per c.ft. or Rs. 4,785. Assuming that the crop is only 75 per cent. stocked the value becomes Rs. 3,600, the present value of which with a rotation of 120 years and 4 per cent. compound interest is Rs. 32-6-0.

The State is receiving Rs. 3,600 per acre and even if Rs. 50 an acre is spent on replacement still obtains a very handsome income, in spite of what financial pundits may say. In all elaborate calculations of compound interest neither correct rates of interest nor correct prices at the end of the rotation are known and with two unknowns such calculations are of little value; but in the above example all we are concerned with is the replacement of the crop as cheaply as possible and provided we do this within some reasonable limit we still have a handsome income.

Th case of afforestation of new land is a different matter and before undertaking this business from purely financial motives some idea of the financial possibilities must be obtained. The most important of these is the cost of planting and the value of the crop at rotation age. For a proper calculation money yield tables are required or at least an estimate of the anticipated nett revenue per acre on the rotation adopted with the years in which it occurs.

The only existing yield tables for India are those for teak at Nilambur and using these, assuming 75 per cent. of the recorded increment figures, it appears that on an 80 year rotation Rs. 1,250, Rs 600 and Rs. 200 could be spent on the three quality classes respectively, with interest at 3½ per cent. and more if the rate is higher (*e.g.*, the Quality Class II figure becomes Rs. 870 if 4 per cent. is used).

The same calculations for *Gmelina* on a 40 year rotation taking increment at 5/3 that of teak and values at 1/4, give a permissible cost of Rs. 200, again reducing returns by 75 per cent. for incomplete stocking. *Burma* (1924-25 Research Report, p. 30) considers (calculating at 4 per cent. compound interest) that a final yield of Rs. 1,000 per acre at 80 years will admit of an expenditure of Rs. 50 per acre during the first ten years; thinnings are ignored. In contrast, the Nilambur figure for Quality Class II is Rs. 9,000 from final yield only at 80 years, *plus* Rs. 6,900 from intermediate yields accumulated at 4 per cent. compound interest to the end of the rotation.

Similarly for sal the final yield at 100 years may be taken at 2,000 c.ft. sawn timber to which may be added 500 c.ft. of thinnings. The stumpage value is from 12 annas to Rs. 2 per c.ft. and is taken at Re. 1-8 per c.ft. so that the value of the crop becomes Rs. 3,750 or say Rs. 3,000 per acre allowing for 80 per cent. stocking. The present value of this at the fixed rotation is Rs. 59-6-0 and this is the sum which could be justified on the afforestation of new areas with sal. In this connection we have investigated the costs of planting both in India and in other countries and information on this point may be of interest to our readers. Indian costs during recent years are as follows (excluding cost of land, buildings and overhead):—

1. Punjab irrigated plantations, 1925-26—

Daphar	...	.	Rs.	26	per acre.
Kot Lakhpat	...	...	„	21	„ „
Riverain	...	...	„	24	„ „

2. Burma Teak—

Tharrawady (1923)	...	„	20	„ „
Taungyas ...	...	„	15—20	„ „

3. *Burma mixed species*—
Tharrawaddy (1923) about ... Rs. 12—15 per acre.

4. *Casuarina Plantations*—
Bihar and Orissa (1924) ... " 8 " "
Madras ... ... " 30—60 " " (large transplants and watered.)

5. *Bengal Sal Taungyas*—
Buxa (1921) ... " 18—22 per acre.

6. *Bengal Hill Taungyas*—
Kurseong (1922) ... " 51 " " (transplants).

7. *Ravine Afforestation, U. P.*—
Etawah (1920) ... Rs. 27-8-0—60 per acre.

These figures are fairly reasonable judged merely from the financial point of view. With them may be contrasted the cost of planting by the Forestry Commission in Britain. This information we have obtained from their annual report for the year ending 30th September 1926 which has lately come into our hands and the costs of planting given are defined to include all operations on a plantation up to the end of the first year and includes preparation of the ground, drainage, fencing, cost of plants and their insertion in the ground and weeding for the first year. The costs per acre for labour and material for planting only for the years 1923 to 1926 are as follows :—

Year.	England and Wales.	Scotland.	Great Britain.
	£. s. d.	£. s. d.	£. s. d.
1923	5 8 9	5 16 7	5 12 0
1924	5 4 6	6 5 1	5 11 8
1925	6 10 3	7 19 3	7 1 6
1926	5 16 10	7 10 3	6 7 7

As regards further expenditure this is classed under "establishment" and all that can be said about final costs is that on a total of 71,000 acres planted between 1919 and 1926 the cost has averaged £8-17-4 per acre. This may be compared with the following costs of Government planting in South Africa which have been obtained from Dr. Sim's book "Tree Planting in South Africa":—

			£	s.	d	
1910—1914	average	...	12	4	3	per acre.
1915—1919	„	...	22	4	3	„
1920—1924	„	...	24	10	5	„

We presume much of this consists of *Pinus radiata* which the New Zealand Forest department are planting for £8 per acre. We cannot help thinking that unless the returns expected are very high and that these can be realised on a short rotation an expenditure of £24 per acre is excessive. No doubt other motives than pure finance, as in the case of the Etawah plantations, have influenced planting in South Africa. If indirect benefits are included in the calculation the ravine plantations of the Afforestation division in the United Provinces are a success financially. These plantations produce quantities of excellent fodder and Government will never again have to spend large recurring sums on the importation of fodder to keep starving cattle alive. Mr. Henry Ford says that production is the guiding star of business, not finance nor profits; that profits follow production as a matter of course; and if we take production as the guiding star of our profession and strive to make every acre produce its maximum we need not be too particular to propitiate the gods who preside over tables of compound interest.

GENERAL THOUGHTS AND OBSERVATIONS ON FORESTRY IN SIAM.

The Kingdom of Siam as a country suffers from some natural disadvantages but possesses undoubtedly many natural advantages, and amongst these may be reckoned the great, universal

and extraordinarily varied forest wealth, which Providence has bestowed upon it.

In an article which was published in the *Indian Forester* of June 1927 I have already briefly indicated the extent of this wealth and I need only add that Siam is essentially a forest country before anything else ; that forests play an enormous part in the economic life of the people ; that a very considerable proportion of the many races inhabiting Siam live in, on, and by the forests ; that Siam is a very large exporter of every kind of tropical forest produce to the markets of the world.

Siam falls naturally into five divisions—the first and most important from a forest point of view is Northern Siam, an area of some 50,000 square miles, which lies approximately between latitudes 16° N. and the northern boundary of the country, in latitudes 19° 40′ and 20° 30′ N. This part of the country consists of a series of parallel hill ranges and valleys lying north and south. The whole tract is hilly and even mountainous in places, containing some of the highest mountain peaks in Siam including Doi Intanon, the highest mountain in Siam, which attains a height of 8,450′. It is served by six rivers, which flow southwards, meeting at various points until they finally form the great Menam Chao Phy a river which flows southwards past Bangkok into the Gulf of Siam. These rivers are fed by a vast number of tributaries, streams, and creeks of all sizes and descriptions and it is noteworthy that in every case these waterways have their sources in Siam, that is to say they are rain-fed, consequently the general flow, the rise and fall and the behaviour of these rivers may be described as both difficult and erratic. Moreover all the main rivers have gorges and rapids, through which it is impossible for rafts to pass.

Northern Siam is thinly populated and sparsely and irregularly cultivated—regular cultivation being confined to valleys and basins, but here as elsewhere in Siam there is a considerable amount of irregular shifting hill-cultivation, practised by a variety of curious nomadic hill-tribes to the great detriment of the hill forests, which also extends considerably into the plains and foot hills—this kind of cultivation is the same as the

taungya of Burma and in India it is well known as *kumri* and also by many other names. In northern Siam as elsewhere in the country the chief cultivation is rice, which is the staff of life to every single indigenous inhabitant of this country.

As regards forest vegetation in this part of the country, the ecology, as usual, is very complicated and difficult ; and accurate data simply do not exist. It may be estimated that 50 per cent. of the entire area is occupied by various types and sub-types of " indaing " forest or forests of deciduous Dipterocarps, growing on soils in which the under-lying rock is of lateritic composition ; 20 per cent. of the whole area may be occupied by mixed deciduous forests, varying greatly in composition which contain teak scattered irregularly and sparsely throughout—these forests grow on many kinds of soils of which the principal are shales and sandstones, but granite and granitic soils also occur largely and some of the finest teak forests are found on basin deposits. It may be estimated that evergreen forests occupy about 5 per cent. of this northern area. These forests are very varied and include both damp heavy impenetrable types of forests in the lowlands, and various kinds of hill and coniferous forests on the uplands and mountains. These hill forests are generally unexploited and often completely unexplored. The rest of this tract may be put down as cultivation of some kind or another.

The second division of Siam to be considered is central Siam which lies immediately south of northern Siam and extends roughly from latitude 16° N, southwards to the Gulf of Siam. This is mainly made up of the great central rice plain, intensively cultivated for rice and containing few forests except in its outlying portions.

Western Siam is a wild, unknown and undeveloped part of Siam, running along the Burmese boundary and extending north and south roughly between latitudes 14° and 18° N. The northern part of this tract of country drains westwards into the Salween river, while the southern portion contains several streams which make up the headwaters of the Meklong river which flows in a south eastern direction, emptying itself into the north-western corner of the Gulf of Siam. The composition of the

forests occurring in this tract of country is little known, except in the teak-bearing portions. Teak occurs chiefly near the banks of streams both in the Salween and the Meklong drainage areas. From what I have been able to find out, it would seem that this Salween teak has been worked longer than anywhere else in Siam and consequently the forests are in a most depleted condition.

Eastern Siam forms a great bulge eastwards, between latitudes 14° and 18° N. The great Meklong river forms the eastern boundary of this large tract of country, separating eastern Siam from French Laos Territory. Topographically it is a peculiar kind of shallow basin, with the western edge tilted up as a plateau over 1,000 ft. high, and separated from Central Siam by a well-known range of hills clad with the densest evergreen growth. These hills are of evil repute climatically. This plateau-basin gradually slopes eastwards and is drained by two rivers flowing into the Meklong river.

The geological formation generally consists of yellow sandstones and shales, giving rise to sandy and loamy soils. A certain amount of lateritic soils also occur. It is probable that almost two-thirds of this portion of Siam, amounting approximately to 40,000 square miles is covered with dry open deciduous forests most of which are of "Indaing" or what I may call modified "Indaing" types. The Divisional Forest officer who is well acquainted with this region, supplied me with the following rough estimates of the forest crop – 50 per cent. *Shorea obtusa* and *Pentacme siamensis* – 20 per cent *Dipterocarpus intricatus, Dipterocarpus tuberculatus, Dipterocarpus obtusifolius* – 3 per cent. *Adina cordifolia* – 4 per cent. *Xylia dolabriformis* – 4 per cent. *Pterocarpus indicus*—2 per cent. *Sindora siamensis* and 17 per cent. other miscellaneous species. A little evergreen forest occurs along the streams.

Southern Siam occupies the greater part of the Malay Peninsula, starting in the north, say, at latitude 13° 30′ N. near the mouth of the Menam river and stretching steadily southwards to latitude 5° 30′ N. A large axial range of hills and mountains, often rising to several thousand feet elevation, runs down the

centre of the Peninsula, like a spinal-cord, and separates the territory into two well-defined east coast and west coast portions.

This region is densely clad with an infinite variety of evergreen forests, ranging from heavy tropical types in the plains to all sorts of hill types. In this region there is a wonderful wealth and infinite variety of evergreen species, as yet very imperfectly studied. It would tax the skill and energies of a super-botanist to do justice to the botany and ecology of the Siamese Peninsula, so I will content myself with remarking that the family *Dipterocarpaceæ* and the genus *Dipterocarpus* are very widely represented, and also that there are three separate areas of valuable coastal mangrove forests in Southern Siam, one at the mouth of the Menam river, the second on the east coast of the Peninsula and the third and largest extending more or less along the entire length of the west coast from the southernmost point of Burma to the northernmost point of the Malay States. In southern Siam also, I may remark that vast forest areas have been ravaged by shifting cultivation.

In addition to the five natural divisions which I have very briefly described, I must also mention another small portion of Siam which hardly falls into the above, namely South-eastern Siam, the extreme south-eastern corner of the Kingdom, on the eastern shores of the Gulf of Siam, comprising the province of Chantaburi. This tract contains inland large evergreen forests and on the coast another small, but largely exploited group of mangrove forests.

It is necessary to enumerate and to describe briefly the general conditions prevailing in the country, which have direct bearing on forest questions, and without which it is impossible to understand the circumstances in which the Royal Forest department works in Siam. These conditions differ largely from those prevailing in India and Burma.

The basis of systematic forestry—as I understand it—is land control. Land-control, as applied to forest lands, depends largely on two factors, namely, forest law and forest maps, so I will deal with these first.

No regular and complete Forest Act exists in Siam. From 25 to 30 years ago, when forestry and the Forest department first started in Siam during the reign of King Chulalongkern, a small number of Royal Decrees were issued to ensure the protection and better working of the Northern Siamese teak forests. From 1912 onwards the Siamese Government began to take an interest in the protection and exploitation of trees of other species than teak, and in 1913-14 a Royal Decree was passed for the protection of such trees, together with Rules and Regulations emanating from it.

Under this authority trees of other species than teak (known generally as otherwoods trees) are divided into two divisions (1) Unreserved trees and (2) Reserved trees. Anyone can fell and use Unreserved trees, but in the Reserved division, trees are divided into three classes as follows—(*a*) very valuable kinds of trees which may not be felled at all; (*b*) valuable kinds of trees; (*c*) less valuable.

Minimum exploitable girths are fixed for the various Reserved species, under which no tree may be felled.

Anyone wishing to fell and use Reserved trees of classes (*b*) and (*c*) must take out a permit from the Forest department or the Revenue department, should there be no Forest department station in that part of the country, and must pay royalty fees fixed by the Government. This also applies to other kinds of forest produce other than timber produced by such trees. Free permits are also issued for various charitable objects and also to cultivators under certain restrictions.

The operation of this Royal Decree is now being gradually extended over the country, although there is still a considerable proportion of the forests which are as yet either unexploited or very little worked, and in such localities nothing is needed.

The species of trees notified under this law, together with the exploitable girths and the rates of royalty levied, vary according to the localities and to local circumstances.

For the last 12 years or so, periodical efforts have been made to introduce a regular Forest Act whereby State forests could be constituted as Reserved Forests, and a forest settlement of rights

and privileges drawn up, together with demarcation and other necessary measures. Such efforts, however, have never met with the slightest success and the matter has invariably petered out into oblivion.

Only one-fifth or one-sixth of the total land surface of Siam has been surveyed and mapped out with accurate modern topographical maps, and such maps are largely confined to the great central rice plain, the main source of Siam's wealth, together with a few outlying portions. In all the rest of Siam the only maps available are rough reconnaissance maps or mere sketch maps, of varying scales. The most that can be said of such maps is that some are better than others. No accurate forest work nor any other kind of accurate work can be carried out from such maps.

Forest maps are hardly in existence at all, in fact the only example of such is the mapping out of certain mangrove areas on the west coast of the Siamese Peninsula by the Forest department. This work, which was largely due to the enterprise of local Siamese forest officers has been carried out on the scale of $\frac{1}{20,000}$, by means of prismatic compass and floating cane measurements. In the absence of triangulation the work of course cannot be accurate, but in the absence of anything else, it is of considerable value locally. The Forest department in Siam possesses no survey staff, and in many Forest divisions there is no complete equipment of the simplest survey instruments ; moreover, the small trained staff is usually so completely immersed in revenue collection, that forest survey work of any kind is of the rarest occurrence.

In 1923 a scheme was drawn up under the general control of the Minister of Agriculture and the then Chief Conservator of forests, for the survey of the whole of northern Siam north of latitude 17° N. on a scale of $\frac{1}{40,000}$. The actual work was entrusted to a British Survey officer of long experience in Siam, whose all-round knowledge of rural Siam is probably unsurpassed by anyone. Besides making a general survey of the country, the teak forest areas throughout were to be marked as accurately as

possible on the maps and it was also proposed to add certain other forest information as well. The survey programme was to be completed in 20 years' time, at an annual cost of 100,000 Ticals.*

Without going into any details, I need only say that after the first season's work the scheme was completely abandoned chiefly, as usual, for want of funds and also for other reasons.

No regular programme of silvicultural work has ever been drawn up and carried out in Siamese forests. Such operations of this nature as have been carried out, have been of a very meagre intermittent and spasmodic nature, due largely to the energy of a few individual forest officers who obtained with difficulty the smallest sums for such purposes. Creeper cutting has been carried on fairly regularly in the northern teak forests, chiefly by the agency of teak girdling parties. A little improvement felling work has been done here and there, from time to time. About 300 acres of regular teak plantations have been created in northern Siam. A few sample plots have been established; one working-plan for a small departmentally worked teak forest of 24 square miles in area, on the Brandis selection system, was drawn up by a Siamese forest officer a good many years ago, and has been regularly carried out ever since. Before leaving this subject I might add that unfortunately no decent records have ever been kept of such little silvicultural work as has been accomplished, consequently it is impossible to refer to it in any detail.

Literature dealing with Siamese forests and forestry can only be described as extremely meagre. A list of the common trees, *shrubs, etc., in Siam with their vernacular names was compiled by* Phya Van Prük Picharn, F.L.S., Conservator of Forests, and published in 1923 by the Bangkok *Times* Press. This is a most useful work, but it is a great pity that it is not being revised and enlarged as the botanical knowledge in the country progresses. Mr. Lloyd (for 19 years Conservator and Chief Conservator of Forests in Siam) compiled summarized reports of the first 20 years working of the Royal Forest department of Siam together

*100 Ticals=120 Rupees approximately.

with notes on various forestry subjects. This is a valuable record bound and printed in a small volume, but not available to the general public. A small summary entitled "Forestry in Siam" is to be found in the yearly Bangkok Directory. A few articles have appeared from time to time in the Siam Natural History Society and the Siam Society (both these excellent institutions are now merged into one), and in the "Record" a valuable economic quarterly issued by the Ministry of Commerce, Bangkok, these, together with a few articles which have appeared from time to time in the pages of the *Indian Forester* complete the written word as applied strictly to Siamese forests; with the exception of some short references by various authors in books on Siam—some of these references being of considerable interest. It must also be added that no printed annual reports have ever been issued, in striking contrast to some other Government departments who issue informative and well-illustrated printed annual reports.

Botanical knowledge is naturally of great importance to the development of Siam, and it is a pleasure to be able to remark that the country has been fortunate in possessing for a good many years past, a small but devoted band of botanists, both European and Siamese, and it is probable that more progress has been made in systematic and economic botany, than in any other science. A few years ago an Economic Botanical Survey department was established in the Ministry of Commerce, and Doctor A. Kerr, M.D., for long known as the foremost botanist in the country, was appointed as Director. Doctor Kerr in collaboration with Professor Craib is gradually identifying the most extensive flora of the country, and lists are being published by the Siam Society. It is much to be hoped that, in the distant future, all this work will lead to the publication of a regular descriptive and illustrated Siamese Flora.

Geology is a subject of great importance to Siam, chiefly on account of the country's actual and potential mineral wealth. At the present time, tin from the Siamese Peninsula provides the second largest item of Government revenue. The subject is naturally also of interest and importance to Siamese forestry,

No regular and systematic geological work has been done; with the exception of a short essay published in the Bangkok Directory and certain interesting references in various books on the country, the only scientific publication that I was able to obtain was the Reconnaissance Geological Report drawn up by Mr. Wallace Lee, Petroleum Geologist, in connection with his prospects for oil in Northern Siam, published by the State Railway department. This publication, together with its sketch maps and sections is very informative, but it only represents a few months' hasty work.

No separate publications on entomology exist as far as I am aware, but there are some interesting contributions to be found in the Journals of the Siam Natural History Society. This subject is of importance to forestry in Siam, mainly owing to the universal damage done to teak timber by the bee-hole borer, throughout the teak forests of northern Siam. This dreadful pest has never been studied at all in Siam.

Before leaving this short summary of general conditions prevailing, which affect forestry directly or indirectly in various ways, I will briefly refer to land-tenure.

The only part of Siam which has been surveyed cadastrally is the great rice plain in Central Siam. In this region the owners of the greater part of the more valuable rice-producing lands have been provided with regular title-deeds.

Elsewhere land is held either by a tenure which is known as a "chap-chong" which gives virtual possession of the land, or much more generally by another kind of tenure, known as "Bai Yiap Yam," which is merely confers temporary tenure or squatter's rights, more or less, on the occupant.

In all questions of land policy in Siam the main guiding principle must be the steady and continued expansion of *permanent* and not temporary cultivation. Economically agriculture, especially rice cultivation, dwarfs everything else in Siam, and everything, including forestry, must be subordinated to this object.

Outside Central Siam I can only describe the conditions governing land tenure and land policy in general, as absolutely chaotic, In fact, there is no sort of policy at all, and the results

have had and are having the most deplorable effects on the country and its inhabitants.

No attempt is ever made to plan out and to classify the lands in any tract of country. Unrestricted shifting cultivation is rampant throughout the country; it is supposed to be controlled by a few primitive rules, but these rules to my knowledge are almost invariably disregarded. The civil authorities occupy themselves in giving out patches of land for cultivation, here there, and everywhere on temporary tenure (bai yiap yam) without any kind of system or forethought. It may be that they think that the occupants will establish permanent cultivation, but in a vast majority of such cases the occupants simply burn the forest growth, take a crop or two of the land, and then abandon it.

Before leaving Siam Mr. Lloyd (for 19 years head of the Siamese Forest department) wrote as follows:—"In advocating the immediate reservation of forests it must not be thought that I overlook the prior claims of agriculture to consideration......... ....But I maintain that forests are a necessity and they cannot be overlooked or neglected for long with impunity. Such neglect has caused wide-spread havoc and loss in many countries ....and agriculture itself has been the heaviest loser .... Every month valuable forests are being more and more riddled with patches of cultivation, which will render the selection of compact blocks of forest more and more impossible. Every month forests are being hacked down where the welfare of the country and agriculture itself demands that they should be preserved."

I will now pass on to give some account of the actual work of the Forest department in the forests of Siam.

Forestry started in the northern Siamese teak forests and it is there that it has reached its greatest development, in fact it is the only part of the country where any attempt has been made to carry on a simple and primitive sort of systematic exploitation.

Originally the entire control of the Siamese teak forests was in the hands of the Lao chiefs, who in those days had more or less sovereign powers, under the general suzerainty of the King

of Siam. Since ancient times these chiefs derived considerable revenues from the exploitation of their teak forests and they issued various kinds of permits and leases to all sorts of teak traders who were chiefly Burmans, Shans, and Chinese by race. The chiefs appointed their relations, attendants, and servants to supervise the working of the forests, after a fashion, and more especially to collect the revenue in the shape of royalties on the teak logs. This royalty had to be shared with their suzerain lord, the King of Siam.

In the late eighties and early nineties of last century a number of European firms entered the teak trade and rapidly gained a predominant control of the teak industry. The arrival of the Europeans caused a great increase in the output of the teak logs and in the competition for teak leases. It also immediately accentuated and brought to light the hopeless confusion which was then in force, accompanied by a vast amount of corruption. It also became increasingly evident that there was considerable danger of the teak forests being overworked and exhausted in a comparatively short time, so the Siamese Government, which really meant the celebrated and enlightened King Chulalongkorn, decided to start a Forest department and obtained the services of an experienced British Forest Officer from Burma, Mr. H. Slade, for that purpose.

Mr. Slade arrived in 1896, and the result of his great work and activities may be summarized as follows :—

(*a*) A small regular forest staff was recruited, which was almost entirely British and included in the early years a small number of I.F.S. and P.F.S. officers. The agents and servants of the Lao chiefs were removed. Some young Siamese, after the lapse of some years, were also selected and sent abroad to study forestry. It may be remarked that, nowadays, the European staff has almost completely disappeared.

(*b*) The area comprising teak forests was divided into forest divisions for purposes of control. General explorations were carried out, and a fair amount of rough exploratory mapping was accomplished, together with the collection of general information and data.

(*c*) Control of actual exploitation had fallen into the greatest confusion owing to past malpractices. In many cases the same leased area had been granted to several parties at once, and violent quarrels were in progress. Moreover, a vast number of disputed teak logs were lying all over the forests and it was often impossible, or nearly so, to ascertain the real ownership because of the forged hammer marks on such logs and of the then prevailing habit of super-imposing hammer-marks one on top of the other. For many years after the start of the department much of the energy of the staff was taken up in settling such disputes. Mr. D. O. Witt, I. F.S., then serving in Siam, has left an interesting and lively account of the early trials and struggles of those pioneering days in the July 1904 number of this journal, entitled "The use and abuse of forest work in Siam."

One of Mr. Slade's first important measures was to obtain sanction for the introduction of a system of regular teak leases, after which, nobody was allowed to work any teak forest without holding a regular lease granted by the Siamese Government. The main provisions of these leases were that each leased area was divided into two halves, each half to be worked over in six years, thus fixing the felling-cycle at twelve years and that no teak tree below 6′ 4½″ in girth at breast-height could be girdled and felled. In some isolated cases the exploitable girth was fixed at 7′.

In some leased areas no further girdling of teak trees was permitted, owing to accumulated girdled stocks, in other areas two out of five standing trees were allowed to be girdled.

Royalty on teak logs extracted was raised from Rs. 4-8-0 to Rs. 10 per ton on teak logs of 38 cubic feet contents and above, and to Rs. 6 for all smaller logs. A number of other regulations and penalties governed the working of these leases. Selection and girdling were carried out by the lessees under the supervision of the department, owing to the paucity of Government staff.

(*d*) Mainly as a result of Mr. Slade's activities the Siamese Government assumed administrative and technical control over the teak forests, and the Lao chiefs became merely sharers in the profits. Not only this, but Mr. Slade, I think, may be regarded as having played no mean part in the extension of Siamese politi-

cal power and sovereignty throughout Northern Siam. This fact has also been recognized by others, as for instance by Mr. R. S. Le May who, in his recently published and most attractive book on Northern Siam, entitled "An Asian Arcady," on page 62 writes as follows:—"In his work in organising the department Slade naturally met with a good deal of opposition from the local northern chiefs on whose preserves he had naturally to encroach to a large extent; but in the end, after a hard fight he won his battle and this victory weakened the position of the chiefs who never regained their former prestige. Slade may be said, therefore, to have played an important part in consolidating the Siamese Kingdom and to have been of great assistance to the Government in this regard."

(*e*) A certain amount of forest legislation in the form of Royal Decrees, to which I have already referred, was brought into force to promote the regular working and protection of the teak.

(*f*) The felling and removal of young undersized teak trees which had previously been done in wholesale fashion, for the manufacture of house-posts, was gradually put down. Teak timber stealing which had been rife, especially along the main waterways, was also gradually abolished.

(*g*) A timber revenue station was established at Paknampo, the southern junction in the Menam river valley system, about 155 miles north of Bangkok. All teak timber extracted by European lessees was floated down to this station, measured there and royalty and duty collected. Whereas, all teak logs extracted by local lessees were measured and paid royalty in the forests, and were re-measured and paid duty at Paknampo.

For teak logs passing down the Salween river into Burma a timber revenue station was established at Kado at a short distance north of Moulmein.

It should also be explained that there are two classes of teak leases, the first granted to foreign firms, and the second a much smaller proportion—to Lao chiefs and other local notables.

This kind of lease lasted down to 1909. In this year, as most of the leases were expiring, it found necessary to reorganize and to improve the entire system of teak leases. The

peculiar and varied manner in which so many of the leases had originated, had given rise to an unnecessarily large number of leases, many of which were extremely small in area. Such leases would be expensive and uneconomic to work, and, on the other hand, difficult to supervise and control. After much negotiation many exchanges and adjustments were effected which reduced the number of leases from 105 to 40. Following the example of Burma the felling-cycle was raised from 12 years to 30. Each leased area was divided into two halves of approximately equal productiveness. Each half to be exploited over a period of 15 years, and all teak trees over 6′ 4½″ girth at breast height were girdled and felled, except certain trees such as seed trees and ridge trees which were reserved for silvicultural purposes. In the local lessees' areas the exploitable girth was fixed at 7′. Owing to the unwillingness on the part of the Government to provide sufficient forest staff, the selection and girdling was again carried out by the firms concerned, except in the case of the local leases. Royalty rates were, on an average, raised by 20 per cent. Certain other measures of reform were also introduced.

This system of reorganized leases was undoubtedly a great step in advance. It placed the whole business of teak exploitation on a better and more systematic basis, and removed many causes of friction between the Government authorities and the firms.

In 1925, as the existing teak leases had come to an end, and the first half areas had been worked over, new leases were drawn up and put into operation. There are 28 new teak leases in force. These leases are also for a period of 15 years and they present a number of improvements over past leases which may be summarized briefly as follows:—

(I) With a few exceptions, the entire selection and girdling of the teak has been and is being carried out by the Forest department. In this way it has undertaken to select and girdle well over one million teak trees, and the successful working of this great operation up to the present, reflects much credit on the two Siamese forest officers, who have been successively in charge of this work. The department could not have undertaken this work had a small increase in staff not been sanctioned.

(II) The exploitable girth has been raised to 6′ 8½″ in the case of all foreign leases, and it remained at 7′ in the case of local lessees. In addition to this 6 per cent. of the best and soundest teak trees are being reserved, besides the trees needed for silvicultural purposes, as before.

(III) The metric system of measuring teak logs has been introduced, instead of the former local system, known as the Pikat system, which was a peculiar system of ancient Burmese origin, but some say it came from China. Standard rates of royalty for average forests have been fixed at Ticals 12·50 per cubic ton (8·83 cubic metres) and smaller rates for smaller logs. In forests of more than average difficulty to exploit, the rate was decreased, and it was correspondingly raised for forests which are easy to work. Duty on teak logs was abolished.

(IV) Waste has been reduced by binding the lessees to fell the trees nearer ground level, and to use saws in felling and logging. A few other improvements have also been introduced.

Approximately 85 per cent. of the teak forests are leased by European firms, 14 per cent. by local lessees, and 1 per cent. are worked departmentally.

General exploitation, in the teak forests, follows that prevailing in Burma, with various local alterations and modifications. The three main courses taken by the logs are down the Menam river valley to Bangkok, down the Salween river to Moulmein, and down the Meklong river to Saigon. In each case rapids and gorges have to be passed, below which rafting can be carried out, so that the logs travel singly for about a third of the distance. Owing to the capricious behaviour of the waterways during the rains, the logs exploited down the Menam take, on an average, about five years on the journey, from the stump to the sawmill.

During the last 20 years or so, with the general opening up and improvement of communications in Northern Siam, there has been a great and universal increase in teak-carting, generally with buffaloes. In recent years also wherever and whenever the quantity and quality of the teak timber made it worth their while, the European firms have indulged in improved transport-

ation methods often of great magnitude and interest—such as, river training works, logging railways, logging tramways, chutes and slides, tractors, and high wheeled carts. During the past 15 years the average number of teak logs exploited from the Siamese forests has been 111,631, and out of these 93,454 have, on an average, passed yearly down the Menam river, paying their dues at Paknampo.

Since the beginning of the Forest department, thirty years ago, as far as I have been able to find out the Siamese Government and the Lao Chiefs have derived a net profit of about thirty million Ticals from the teak forests, and the percentage of expenditure to revenue has probably been 23—24 per cent.

The system of management, obviously, is a rough and ready form of the Brandis selection system. Since 1909, the felling cycle as in Burma, has been fixed at 30 years. It has always been assumed that the general rate of growth of teak in Siam, was about the same as in Burma, and, while I was in Siam, Phra Winit Wanadorn, D.F.O., in charge teak girdling, and his staff, carried out a series of ring-countings and other measurements which gave corresponding results—as far as they went. The main feature of the Siamese teak forests has been the great abnormality of the growing stock, namely, a great surplus of Class I trees and a large deficiency of Class II trees. The results of the past working of the forests has resulted in a steady and large diminution in the capital, and a corresponding decrease in the future producing capacity and output.

In all forest matters in Siam it is dangerous to dogmatize, owing to almost complete absence of scientific data, but when the present leases run out and are cleared up, say, in 20 years' time, then, after this I do not believe that the " first half " leased areas will produce more than 50 per cent. of the present output, and I am quite convinced that 60 per cent. may be regarded as an extreme maximum of output.

To support this I would like to quote what Mr. W. F. L. Tottenham, I.F.S., who served in Siam with Mr. Slade and was his successor, wrote in November 1904, in a now long-forgotten controversy which was published in the local press :—" Mr. Slade

as early as 1897 gave it as his opinion that the possibility of the forests was then being greatly exceeded and unless the fellings were reduced the existence of the forests would be jeopardized ....The average output for the seven years, 1897—1903 was over 75,000 logs a year *whilst the possibility of the Menam valley is probably well under 30,000 logs*." I should like to remark that during the past 15 years, 93,454 teak logs have been annually taken down this same valley !! This gives some idea of the over-felling that has constantly taken place. Conditions have changed much since this was written and personally, after considerable study of this question with such data as are available, I should have estimated a reasonable output for the Menam *valley in the last 15 years at 50,000 logs, annually.*

The teak outlook is a depressing one, both for the government, the firms, and last but not least for the inhabitants of Northern Siam, who obtain much employment and much money, by working in various ways in the teak forests.

In the case of all forest exploitation in Siam other than teak, hardly any attempts at systematic working have yet been made. The lease system has only been developed to a small extent, but a small number of leases exist, most of them of a local character, one firm, the Sriracha Company exploits a large leased area in south-eastern Siam on up-to-date methods with modern machinery. In leased otherwoods areas exploitable girths for the various species to be exploited are fixed, and all trees above these girths are removed.

Apart from such leased areas, the general exploitation of all otherwoods in Siam is regulated by the permit system ; permits are issued usually for fairly small quantities and the operation of the permits is subject to the otherwoods Rules and Regulations.

In the coastal mangrove forests the peculiar situation and nature of such forests have enabled the forest officials to organize the permit system more efficiently ; permits being issued for definite areas of forests, in which the minimum girth system of exploitation is practised, following the example of the working of the mangrove forests in Malaya and elsewhere. While I was in Siam a creditable attempt was made to introduce better and

more regular working into the most accessible portions of the valuable mangrove forests, *on the west coast of the Siamese* Peninsula, by drawing up what would be termed in India a Preliminary Working Plan—as far as local conditions permitted. But this effort proved fruitless, as the Plan was never sanctioned.

Siam possesses an extensive and efficient railway system—3,078 kilometres or 1,760 miles of railway lines being either constructed or under immediate construction, according to the figures given in the annual report on the Administration of the Royal State Railways for the year April 1st, 1924 to March 31st, 1925 (Buddhist Era 2467). The question of providing timber and fuel for the maintenance and running of this large railway system is one of great national importance to the country and its inhabitants. The question of railway timber supply is very important, but it is not nearly so serious as the question of fuel supply. This railway system runs entirely on jungle wood fuel and consumes annually approximately 350,000 cubic metres stacked of wood fuel. Owing to the very wasteful and reckless destruction of forests near the lines it is becoming every year more difficult and more expensive to supply the necessary quantities of fuel, and the more so, because obviously wood fuel will not bear transporting any long distances.

Until recently no start had been made in any kind of organised working, but I am glad to say that by now a beginning has been made in establishing so-called "Railway Fuel Reserves," that is, selected areas of forests producing fuel and timber to be surveyed, roughly demarcated, and their future existence to be guaranteed by the civil authorities—when this has been accomplished, regular felling schemes are introduced. Nevertheless, very much remains to be done and the question should be immediately tackled by the Government on a large scale throughout the country. Unless this is done and very quickly too, there is certain to be a serious railway fuel crisis in the near future.

Financially the general results show a steady increase in revenue but no increase in the percentage of expenditure to revenue. In the year 1896-97, the total revenue was Ticals

728,296 and the total expenditure was Ticals 390,285, whereas in the year 1925-26 the total revenue was Ticals 3,334,882 and the total expenditure was Ticals 732,829 – the percentage of expenditure to revenue, in this year, being 21·3 per cent.

In connection with this I should like to quote what Mr. Lloyd wrote a few years ago, before his departure from Siam :— " In my opinion a Forest department in its early years of existence, as in the case of the Forest department in Siam, should be spending 50—75 per cent. of its revenue, until it is in an advanced stage of development. After the attainment of a fair proportion of this development, the percentage of expenditure could be reduced. Instead of this we are now spending barely 20 per cent. of the revenue derived from forests on the Forest department. Until the forests are in a far more developed and improved condition the Forest department should not be looked upon as a revenue producing department at all.... . ...It must be remembered that the more that is spent on development and improvement now, the greater will be the revenue in the future and the quicker will that increased revenue be obtained."

In 1921-22 the Forest department was transferred from the control of the Ministry of the Interior to that of the Ministry of Agriculture. At present the total staff of all kinds, numbers 618 persons—there are 18 Forest divisions and three Forest circles.

D. BOURKE-BORROWES.

AN INTERESTING FOREST IN THE KAGAN VALLEY, HAZARA.

In the course of a very instructive tour of the forests of Hazara made in May and June this year, one of the most interesting places visited was the neighbourhood of the village of *Narang* on the left bank of the Kagan or Kunhar river, 63 miles above its junction with the Sutlej near Garhi Habib Ullah. Approached from down stream the village presents a most desolate appearance, the low houses being at first hardly discernable scattered among the chaos of boulders which have evidently debouched from a lateral valley

and at one time blocked the main stream. One immediately feels tempted to enquire into the recorded or mythical history of this catastrophe of former times, and reference to the District Gazetteer reveals the fact that local folk lore preserves an attractive account of how it came about. The relevant extract is as follows:—

"Safr Maluk Sar is some six miles to the east of Naran, and is the source of the Naran *katha*. It is about half a mile long by 500 yards broad, and 10,718 feet above sea-level. It is an enchanted lake, and of it the following story is told: There was once upon a time a Prince of Delhi who saw in a dream a fairy of wondrous beauty, and straightway fell in love with the vision. On awaking he sought out the astrologers and asked them where he could find her. They told him to proceed to a certain glen in the Kagan valley above Naran, where he was to spend twelve years in religious devotion. At the end of that time it might be that he would have his wish. Accordingly the Prince, hereafter to be called Safr Maluk, the 'much-travelled one' (from *safr*, travel, and *mulk*, country), betook himself to the glen aforesaid. He found there a vast lake lying at the head of the valley in the tract now called Kach, and a great river flowing down to Naran therefrom. For twelve years he gave himself up to the study of religion in this lonely spot, and then at last his wish was gratified. For one day he beheld Badal Jamal, the Queen of the Fairies, with her troop of 360 attendants, come down to bathe in the river. Unconscious of the Prince's presence, they laid their clothes on the bank and descended into the water. Seizing the opportunity, the Prince snatched the clothes of the Queen away. Whereat the other fairies, scared at his unexpected appearance, hastily picked up their garments and vanished. But the Queen remained helpless in the water, nor would the Prince give back her clothes till she had promised to be his wife. And so his desire was accomplished. But Badal Jamal had another lover, a powerful demon dwelling in the mountains near, and when he saw the Prince about to carry her off, his wrath was great. Hastening to the embankment which dammed the waters of the lake, he burst it open, and let a mighty flood sweep down the valley. But his efforts to destroy the pair were vain, for they escaped to the hill at the lower end of the

glen and stayed there till flood was past. Then Prince Safr Maluk took his bride back to Delhi, and they lived happily ever after. The inhabitants of Naran, then a big city, were not so fortunate, for the flood swept over them and destroyed the place, and its site to-day is marked only by a few huts and by the boulders that the stream washed down. And a further outcome of the flood was that the lake was shifted to the centre of the valley, where it now lies, and was confined within narrower limits. Of the fairies some say that they have deserted the place, others aver that still of nights they come to dance their revels on the grass and bathe themselves in the stream, and then woe is it to the mortal who encounters them!"

An opportunity obviously had to be made to visit such a lake, and I was lucky enough to be able to manage it on a perfect morning before making the day's routine march down the valley on June 3rd. The distance is about six miles with a climb of some 3,000 ft. It was a great chance to make good use of a camera, but unfortunately an Abbottabad photographer managed to spoil just this set of photographs though doing others well enough, and the beauty of the snow covered lake perched up at 10,718 ft. and its basin, does not at all receive justice in Plate II. This visit to the lake was, however, virtually mere sight seeing, and it is rather the consequences of the land slide on the forest cover that seem an appropriate subject for a brief account in the *Indian Forester*.

The small stream from the lake drops very steeply down to a fairly broad valley bottom all under snow at the time of my visit. The relative flatness and breadth of the valley is clearly largely due to its having been filled with the material of the slide. Lower down, at about 8,300 ft., one comes into *deodar* (*Cedrus Deodara*) and *kail* (*Pinus excelsa*) forest. These two species, which also clothe the adjoining mountain sides and old moraine, appear to have come up about the same time—the *deodar* may be older, but I was unable to obtain a ring counting. Some years ago, the *deodar* was apparently all worked out by traders, for though old hacked stumps can be found even close to the village, the only standing trees are two or three, overmature and inferior, at the top end of the strip of the forest. The *kail* on the other hand has hardly been touched,

Photo. H. G. Champion.

Safr Maluk Sar, 10,718 ft. Kagan Valley Hazara. The abode of Badal Jamal, Queen of the Fairies.

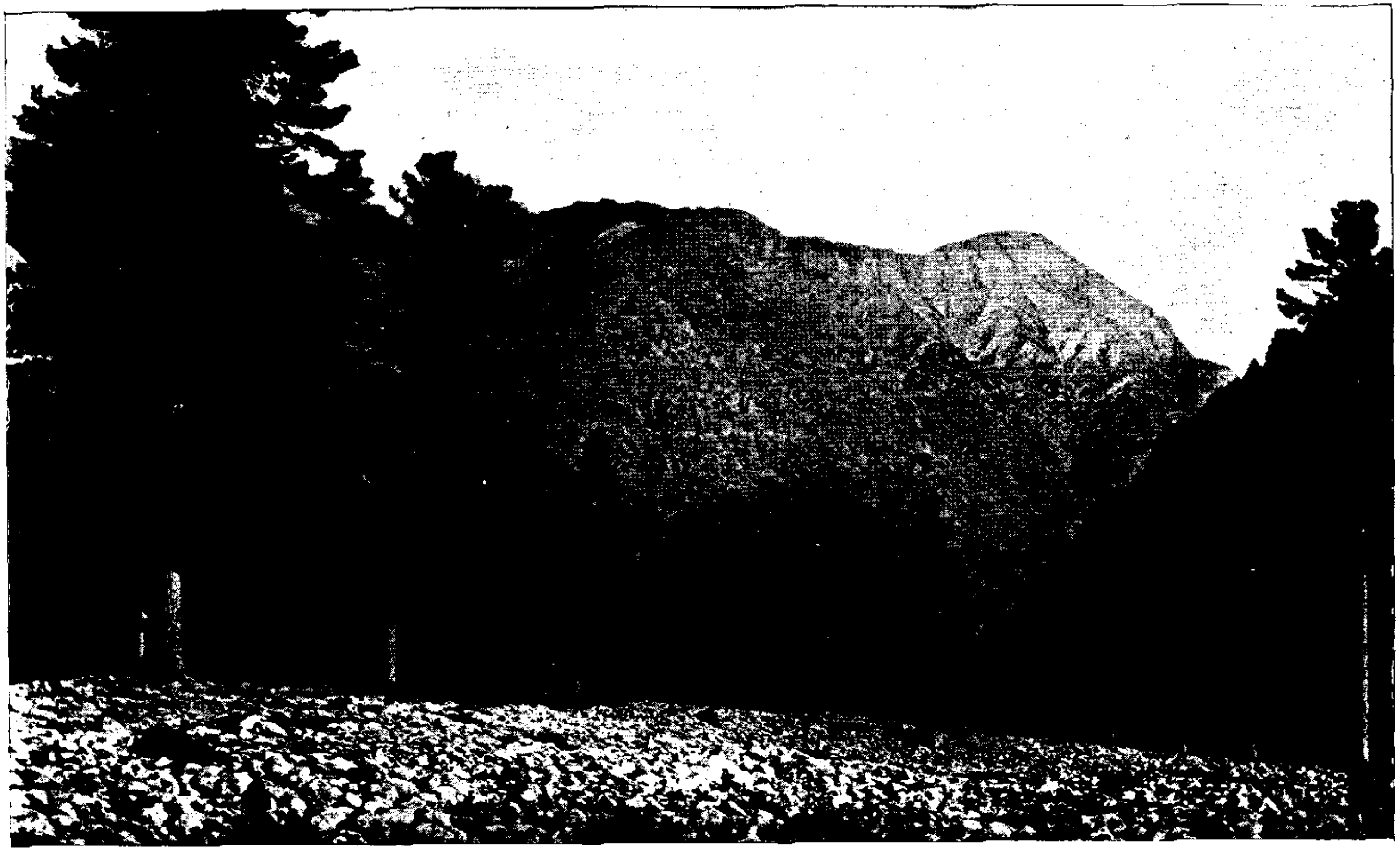

Photo. Mohd. Allah Yar Khan.

The overmature kail crop on the Landslide.

till this season when some 40 per cent. of the trees have been felled. It is a most interesting crop in several respects and the Divisional Forest Officer Khan Malik Allah Yar Khan Sahib has kindly supplied me with some enumeration data to supplement my observations as well as the photograph for Plate 12. The crop height is low, rarely over 100 ft., so that it will only fall into the lowest of three quality classes covering the common range for the species. The age is higher than for any other crop for which I have records, being between 230 and 240 years. The breast height girths vary from 147" to 60" averaging 87½" for the trees removed and 101" for those still standing. The area under this crop is given as 25 acres from which 19,000 c.ft. logs have been felled and about 35,000 c.ft. remain, the utilizable volumes before and after felling being 2,170 and 1,400 c.ft. per acre corresponding to about 3,200 c.ft. and 2,100 c.ft. on standard timber dimensions (πr^2 volume down to 8" diameter under bark) which is slightly less than Howard's Quality Class III *chir (Pinus longifolia)* with full stocking. Plate 12 shows the edge of the area. There was surprisingly little decay considering the age and I have never seen so good a batch of large girth *kail* logs.

On the removal of this overmature crop, what are we going to get in its place? The area is in the immediate proximity of the village and goats and sheep must go through it to reach the grazing ground above. Fire is not a serious menace owing to the bareness and stony nature of the ground. In the lower parts the only sign of regeneration was two bushes, one being *deodar*. It seemed a pity to end its struggle for life but this was done with the reflection that it was surely doomed soon to fall to the villagers' axe. A section near the base revealed 87 rings, and a branch some 2ft. above ground 72 rings, the true age must have been 100 or more, the girth 10" and the height under 5 ft. The other bush was a spruce very similar in appearance. At the top end, a small group of deodar with two spruce poles has succeeded in establishing itself on what appeared to be a gravel bed of later origin.

The portion of the fan detritus facing up the Kunhar Valley also carries the remains of this old *kail* crop, but it is here more open and characterised by a very heavy infestation of the minute

parasite, *Arceuthobium minutissimum* resulting in the formation of witches' brooms and dry tops.

The damming up of the main valley by the slip must have resulted in the formation of a lake, but the valley being narrow and the river having cut its way round the face of the fan of detritus, one now only finds the river bed wide and flat with the water running in a network of channels. A stone's throw up stream from the edge of the slip-material, a small island has escaped erosion for a long period though its destruction is even now under way, and it carries the exceptionally fine blue pine crop seen in Plate 13 on this island.

Omitting the outer fringe, a temporary sample plot of 0·7 acres was laid out. In several respects, it is easily the best on record so far; the crop data are: Age 157 years, Crop height 136ft. (the tall central tree is 150′ high and 8′ 1″ in girth but is not in the plot), diameter 21·8″ (14″ to 29″), and the standing volume of timber (full basal area and down to 8″ diamater over bark) 14,836 c.ft. per acre in 102 stems. This may be compared with 9,340 c.ft. for Quality Class I *chir* at the same age or 16,450 c.ft. for 120 year old Quality Class I *deodar* (Howard's yield tables). These figures are all the more surprising when it is known that a heavy felling, removing two-fifths of the then number of stems was made only nine years before, but four plots have recently been measured in the Parbatti Valley, Kulu, with over 17,000 c.ft. of timber at ages between 70 and 82 years, the crop heights being 120 to 135 feet.

If anyone knows of any *kail* crops comparable to either of those here described, the present writer would be glad to hear about them.

H. G. CHAMPION, I.F.S.

24th September 1927.

A TREK OVER THE RUPIN PASS.

The middle of June 1927 found me at Sangla in the Baspa Valley the guest of a Conservator of Forests. The Baspa is a

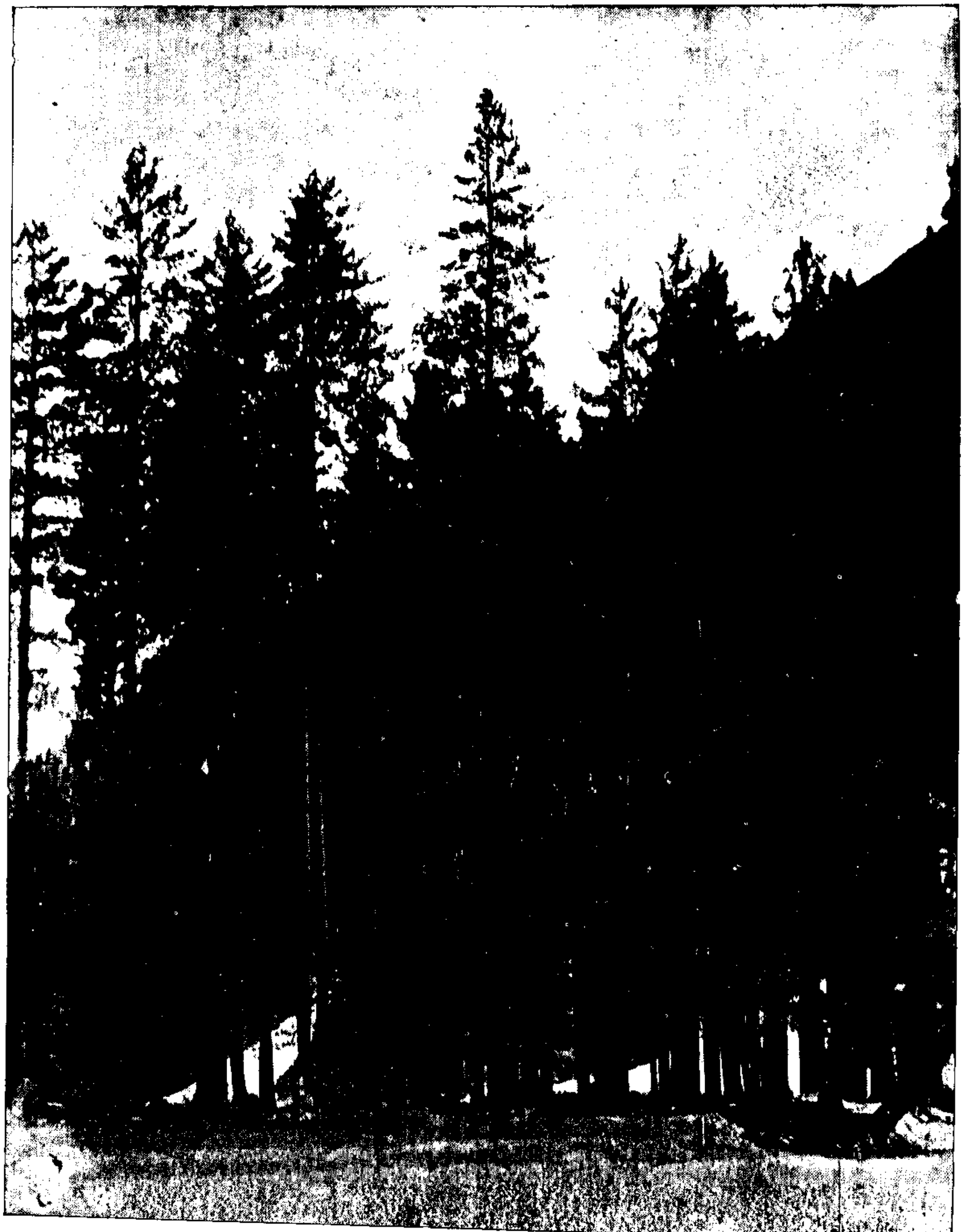

Photo. H. G. Champion.

157 year old Pinus excelsa crop on an island in the Kunhar R., Kangan Valley, Hazara.

very lovely tributary of the Sutlej which joins the latter about 130 miles east of Simla. North of Sangla rise the cliffs and glaciers of the beautiful Kailas massif, the topmost peaks of which exceed 21,000 feet; south there runs a snowy range of lower altitude, crossed by three or four moderately stiff passes, of which the Rupin (15,350 feet) is one. The Rupin is fairly extensively used by shepherds, petty traders and local villagers moving between Lower Bashahr or Tehri Gharwal and Spiti, Thibet and the Upper Sutlej valley. It also forms a 'Pilgrim's Way' and the first tribulation for the pious who go to circumambulate Kailas. Superstition has it that he who makes the complete circuit clockwise round Kailas shall have good fortune all the days of his life. I am sure he earns it!

Though well-known to the local inhabitant, the Rupin Pass lies out of the track of most Europeans. Probably not more than a score have crossed it in the past quarter of a century, including one Lieutenant-Governor. They have been, for the most part, Forest Officers, to whom it is a convenient short cut from Upper to Lower Bashahr, and it was for this reason that my host had included the crossing of the Rupin in his programme. The party consisted of my host, his daughter, myself, and the various subordinates that form the apparently indispensable retinue of the official in India. For some days the omens had not been auspicious. The 'chota bursat' had been making its presence felt, though we were in the so-called dry belt, and had inflicted on us much cloud and some rain. Information regarding the pass was vague and somewhat disquieting. The winter snowfall had been unusually heavy and the spring late, so that the snow was lower by a thousand feet or more than it should have been, while the recent stormy weather was said to have led to considerable falls of fresh snow. The general idea was, however, that if the weather now held fair and our legs and lungs could bear the strain, all would be well; but the weather showed no particular inclination to be helpful, and storms daily powdered the mountains with new snow, while, as for legs, and lungs, these had still to be tested. None of us were mountaineers, and there was a marked tendency for each to acquire Dutch courage by mocking at the

prospective horrors in store for the others. On the morning of our start a Forest Guard, sent by the Ranger on the far side, arrived with the news that the Pass was in none too a good condition, that there had been a further fall of six inches of snow, and that in two places there was some risk of avalanches. To counter these dismal croakings he announced that steps had been cut in the worst places, and that, barring a further heavy fall of snow the crossing was practicable. Thereupon we beat up a bit more Dutch courage, packed up our possessions, and set forth.

The first march was easy. The track ran high up on the hillside above the nullah behind Sangla, first through forest, and then along the open downs with their varied and charming assortment of wild flowers. For a while, on looking back, we had glorious views of the Kailas snows, but these soon vanished under a grey veil of cloud. Ahead of us also the snow-clad slopes of the mountains lost themselves in mist, allowing us hardly a glimpse of the morrow's objective. After climbing 3,500 feet in six miles, and while still a full hour's march below the recognised camping ground of Nuru Tach, low-lying snow compelled us to call a halt for the night, and as we did so a solid mass of black cloud came swirling down the slopes above and threatened to swallow us up. All hands turned to and ran up the tents just ahead of a flurry of hail and rain, which proved the fore-runner of a two hour downpour, accompanied by a keen, biting wind, determined to impress us with the fact that at 11,700 feet we were not entitled to any comfort. We swelled like bullfrogs as more and yet more clothing was donned, but not one of us was able to claim to being more than approximately warm. Towards sunset, however, the rain ceased and the clouds lifted enough to disclose the snow above and even a glimpse of the head of a nullah which lay somewhat to the east of the Rupin ; the Rupin itself was hidden by a shoulder of the downs. We at once sallied out to warm up the circulation, and came across some yak grazing above the camp, which the feminine element immediately proceeded to sketch, the while that we menfolk made the sort of noise we supposed yak would appreciate, which said noise kept the beasts petrified in a contemptuous stare until long after the masterpiece

was complete! The last look round between an early dinner and an early bed was not encouraging. A swirling bank of cloud lay low down on the hills and periodically poured out on us short, cold showers accompanied by bleak gusts of wind, and altogether it was a wretched night, which foreboded anything but well for the morrow.

At four o'clock in the morning life was an even more gloomy affair than it had been the night before. Black clouds were trailing along the sides of the mountains shedding squalls of cold rain, the air was raw, the wind ate into our bones, and such snow as was visible looked intensely uninviting as it lay bathed in a mixture of watery moonlight and sickly dawn. Our guide, however, pronounced the Bashahri equivalent of "Excelsior!" and gave it as his opinion that the clouds would break and the weather mend presently, so we dressed reluctantly, swallowed a somewhat scrambled breakfast, and again set forth. For an hour the going was good and the path free from the snow that lay on either side, also reasonably level. The clouds were trying very hard to break, and at one time a feeble gleam of pale yellow sunshine actually pierced its way through, but that was all we saw of the sun throughout the day. At Nuru Tach, which should have been our camping ground on the previous night, we stepped on to the snow, and did not quit it again for seven long miles. For a while the line taken was a steady uphill gradient along the white slopes of the downs, and progress was good; then our guide turned down hill on to the snow bed which filled the nullah below. This was not much of a drop in reality, but legs and lungs were just beginning to feel the height, and we grudged the wasted labour of going uphill only to go down again. We hit off the nullah at about 13,000 feet and saw ahead of us a long, uptrending snow field enclosed by great, white slopes, and ending in a series of cliffs below the pass, which appeared to be about two miles away. The slope was steep enough to make walking a distinct effort and I began to find myself decidedly short of breath. Also the weather, which up to this had really been trying to be kind, went back on us. Reinforcements of black cloud poured over the pass shrouding us, and everything else, in

mist, out of which a fine sleet began to fall, and this soon turned to a snowstorm which lasted the best part of two hours. Fortunately there was not much wind until we were close under the crest of the pass, so that the change in the weather was annoying rather than serious. At about 13,700 feet, and with a view to faster progress, the lady of the party allowed herself to be harnessed into the bight of a rope with a Bashahri coolie hitched on to each end, but this arrangement quickly drove her to protest against the strain on her olfactory nerve,—Bouquet de Bashahr is a concentrated scent! Eventually she was fastened to one end of the rope and the coolies to the other, but even this was only a partial solution to the problem!

At 14,300 feet cliffs forced us out of the snow bed and on to the final slopes leading to the crest, and the real struggle began. The angle of ascent was very stiff, and, though steps had been cut in the worst places, these had been filled with fresh snow. Also the step-cutters, over estimating our leg power at those heights, had cut them too far apart, so we were driven to kicking intermediate steps as we went along,—an occupation needing breath and energy that could ill be spared. The higher we went the keener blew the wind and the faster fell the snow, which was rather trying, since aching legs and 'bellows to mend' forced frequent halts, whilst the cold forced frequent starts, so that our progress was a series of spasmodic gasps and spurts. For the last five hundred feet I was too busy trying to keep my legs working and lungs from bursting to be interested greatly in anything else. There was a moment when life would have been brighter could I have been sick, but, finding neither breath nor energy for the necessary drill movements, I had to leave it at that.

A cairn of stones looming out of the mist showed us the crest, and we thankfully breasted the last hundred feet of slope not, perhaps, in the best of form, but anyhow we got there! In fine weather the view must be magnificent, but all we saw through a flurry of snow was a snow cairn and a narrow snow culoir, sheer as the side of a steeple, leading down between black cliffs to vanish in the mist a hundred feet below. A biting wind sent us hurrying down this culoir with hardly a pause for breath.

Saw ahead of us a long uptrending snow field.

Snow slopes on which the loaded coolies had great difficulty in keeping on their feet.

Sarbasan was a somewhat gloomy and bleak spot. Slide surrounded by patches of deep snow.

Fortunately the steps cut in the snow by coolies two days earlier were there, or the descent would have been a slow and tricky affair. As it was the procession was not without its comic side. Three coolies led the way, frantically clearing the fresh snow from the steps and making a fairly indifferent job of it; I followed with cries of "Shahbash!" and "Chelo!" whenever there was breath to spare; my host came next and acted as buffer-stop to his daughter. She had quite the worst time of it, for she and the coolies had reversed their order of march to safeguard her against a possible slip, and, in their zeal to prevent her from going too fast, they braked her so heavily that, as often as not she was to be seen leaning forward on one foot while the other waved frantically and ineffectually in the air striving to reach down to the next foothold. A string of Forest Guards, coolies, and odds and bobs in general brought up the rear and made quite a long tail to the procession.

At the end of a 400 or 500 foot descent everything seemed to come right all at once. The culoir ended on a comparatively level snow field, the wind dropped away, the snow ceased to fall, and we emerged below the cloud level. From now onwards the descent was merely a matter of footslogging for some four miles over snow fields alternating with steep snow slopes on which the loaded coolies had great difficulty in keeping on their feet; indeed those with loads not likely to come to any harm found the most effective method of progression was to sit down and slide. The clouds did not lift off the hills until late in the evening, so we moved, for the most part, in a white walled, white floored tunnel with a grey roof. Occasionally the white walls broke into black, precipitous cliffs, and once the new-born Rupin river made its first appearance from under the snow at the lip of a 250 foot cliff, plunged down its face in an exquisite, feathery cascade, and vanished once more into the snow below.

The last snow slope encountered was the steepest, and perhaps the only one where real danger was present. It lay immediately below precipitous cliffs, the ledges and crevices of which were filled with ice. The altitude was only some 11,000 feet, and the warmth of mid-day was melting the snow fast. Every

now and then a loud crack would herald the fall from the cliff of a mass of ice weighing anything up to several tons ; this would crash on to the head of the snow slope, break with a roar into a thousand pieces, and come rattling down over the snow with the sound of a multitude of kettle drums, to finish on the snow bed in the nullah below. I witnessed two such falls while waiting for the last of the coolies to negotiate the slope, and the snow was scored with the tracks of previous falls. A few hundred yards further we stepped off the continuous snow and marched a couple of miles or so over alternate patches of snow and patches of swamp to the camping ground of Sarbasan. This was a somewhat gloomy and bleak spot shut in by steep slopes and still surrounded by deep snow drifts in spite of its comparatively low elevation of 10,500 feet. Nonetheless we were very glad to get there, and to rest our weary legs after what had been a long and strenuous day's work.

It had been a day to remember. The weather had been wretched, and had spoilt some of the fun and enjoyment of what was still a great experience and a most interesting venture. Needless to say, the pass grows higher and the snow slopes steeper as the months go by, and there are humble moments when I wonder whether we have not made a mountain out of a mole hill. Still, it was "some mole hill"!

"A. B. C."

EFFECT OF NEGLECT OF THINNINGS IN TEAK PLANTATIONS.

At the end of an interesting note on thinnings in the November *Indian Forester* the writer asks whether the neglect of thinnings in teak plantations results in a permanent deterioration of the crop.

In Burma there has been until quite lately a general disbelief in, rather than neglect of, thinnings and nearly all the older plantations were badly overcrowded with the result that the crowns are restricted, the soil often bare and eroded and undergrowth absent. Some plantations had never been thinned until recently.

Girth increment has, of course, been very slow and consequently the volume is deficient and can never be made up within a normal rotation but I do not think that, except perhaps in the worst cases where the soil has suffered, the trees have been so injured that they can never resume a rate of growth which can be considered normal for thinned plantations.

That nearly all teak in natural forests suffers in early years from prolonged suppression is shown by the working plan records of ring countings. Roughly it takes a tree 40 to 50 years to reach a girth of three feet, an average of $\frac{1}{3}$rd of an inch per annum. Later, those trees which become dominant grow at a very much more rapid rate. On the average trees of 6′ 0″ reach a girth of 7′ 0″ in 15 years, an increase of nearly 1″ a year. If the trees in the natural forest can recover there seems no reason why those in plantations should not do so if they are carefully treated.

Height growth is not so likely to be affected by overcrowding as girth growth. The natural thinning out of the crop proceeds rapidly during the first 20 years and it is at about this period that the trees start forming a definite crown which implies that no greater length of clean timber would result even if the trees were well separated. If the total height growth is reduced at all the reduction will be in depth of crown rather than length of bole and as the crown often covers as much as half the total height a considerable part of it is probably quite unnecessary.

The period which must elapse before a normal rate of growth is resumed must depend on circumstances.

In the case of the crowns the damage caused by overcrowding is, I think, mainly confined to the twigs which become covered with callus growth owing to the wounds caused by the knocking off of the very tender buds which are produced at the end of the hot weather. In an overcrowded plantation there is always a distinct gap all round the crown of each tree. This gap is probably not filled because in swaying in the wind the crowns touch and no new shoots can survive. After a thinning takes place a new crown has to be produced and this may take some years if the terminal shoots are covered with callus growth and lack the vigour necessary for rapid growth.

In the case of the root system, overcrowding necessarily results in lack of vigour and the restriction of the area which the roots cover. Where the undergrowth has been killed out and soil erosion has taken place—a not infrequent occurrence—the roots near the surface are exposed and, in the absence of fire protection killed by fire.

Before the tree can resume a normal rate of growth the root system must be developed and in the worst cases where the soil is bare and exposed this may take several years to accomplish but, with fire protection and the introduction of an undergrowth to protect and improve the soil, should not, I think, be impossible.

Some plots laid out in a plantation then 54 years old and now 59 years show that recovery does take place at least to a certain extent.

No thinning appears to have been carried out until the trees were 43 years old. During 1911-12 to 1913-14 a heavy thinning was carried out and an average of 435 trees per acre were removed leaving about 80 to the acre so that at the age of 43 there must have been 500 or more to the acre.

Two plots were formed in 1922 of which one was thinned and the other left unthinned. Both had had the advantage of the heavy thinning in 1911-12 to 1913-14 and as a thinning was necessary in 1922, ten years or so later, it is evident that the canopy had closed over. During the five years 1922 to 1927 the girth increment in the thinned plot has averaged ½" per annum against ¼" in the unthinned plot. This shows that the attention the former has received has resulted in a more rapid increment. A further thinning was carried out in the thinned plot as the canopy had again closed up which shows that the crowns are recovering their vigour. The undergrowth and soil conditions have improved considerably and there seems no reason why the rate of growth should not show further improvement by 1932.

G. S. SHIRLEY, I.F.S.,

11th December 1927. *Silviculturist, Burma.*

A NOTE ON SALAI (BOSWELLIA SERRATA).

Having just completed some work in a jungle containing a large number of *salai*, and not having quite satisfied myself regarding the results, I would like to say a few things and ask others (Forest Officers) with more experience their opinion on one point in particular.

It may be recalled that *salai* generally prefers the poorer soils more especially hillsides and plateaux (in Berar). *Salai* (in places where it already exists) appears to be a very bad " mother " as one very seldom sees young *salai* under its parent tree. Now what are " her " qualifications with regard to " nursing." " She " is certainly seen growing where nothing else grows and certainly starts afforestation on her own in some cases. I think many will agree that *salai* undoubtedly does " nurse " young teak—some say she is not a conscientious " nurse " while others hold the opposite opinion. As regards the afforestation; instances of all the various stages (that of one year old teak seedlings to the pole stage, where the leaders have broken through and are safe to carry on the remainder of their lives in peace—the *salai* in some cases having died) are met. The nearest I have seen to this in the United Provinces are the 'Bojis' of North Kheri division. However in the case of these 'Bojis' there are these three differences :—

(a) Sal is bringing up young sal.

(b) The soil is not so arid as in the case of the *salai.*

(c) Afforestation with the 'Boji' is more confined in area, but appears more rapid in actual growth.

I believe in places *Stereospermum suaveolens* being frost hardy, also help young sal. Of this I cannot say much as I have only seen a few cases where this appeared to be the case.

However whether the protection is there for frost, drought or any thing else, there apparently is a time when it would be beneficial to remove the overhead stuff. This appears to be essential in the case of *salai.* Why? because it branches at a comparatively low height. Yes! often the teak does shoot ahead with a straight bole, but what percentage do this? There is undoubtedly a larger percentage of those which

get their leaders bent and curved at this point. I have seen many such cases, some where the *salai* has died, leaving what would have been valuable teak to take its place—but unfortunately the teak are there with bent crowns or with an ugly-looking bend where it isn't wanted.

Hence I say that the young stuff must be freed from that which brought it into the world, if it is to be of any value in later life. Not in all cases true—like some human beings unfortunately—but one cannot very well tell beforehand and hence it is better to be on the safe side—or is it ?

To get down to details—taking an example from just after the critical period—one or two teak poles have just broken through (straight or otherwise). Here the *salai* should be removed and it is the maximum period it should be allowed to exist.

The real difficulty however is 'how much earlier can it be removed.' Surely the whole thing sounds easy. The teak seeds come, germinate and grow up under the "nurse's" care; then when they are just about to break through the *salai* is removed. What an ideal! but I may ask where are the 'moneys' and the staff to work this convenient arrangement so kindly supplied by Nature.

A coupe is worked this year and may not be entered again for another ten years or more. On entering the coupe for the first time all the stages are met and on entering it ten years later some damage is visible—damage which could have been avoided at the first entry.

Thus it boils down to this again—'what is the earliest date at which the *salai* can be removed ?'

One might say in a bold manner "Remove the *salai* if you think the teak will reach its branches within such and such a period." But one must consider many things at this stage—amongst them are :—

(*a*) Are the poles going to push through ?

(*b*) If so, will they be straight ?

(*c*) Is the quality (*i.e.*, actual height growth more than formation of bole) going to deteriorate by the removal of the *salai* ?

The answers to (*a*) and (*b*) may either be "Yes" or "No," and either may be right or wrong. But still they need consideration when the problem is before you in the field. No doubt areas do exist where the area is so poor that both (*salai* and teak) are still required standing—here of course "Nelson's blind eye" would come in very useful; the area being passed over without removing anything.

Thus I have found that it is the answer to (*c*) which is all important, and on which most stress must be laid in most cases. The teak is there (be it good or bad in quality—it being up to the Forester to get the best out of the material on hand) something must be done and quick. There arises the eternal question "Shall I or shall I not." Which being translated, in most cases, means "Will there or will there not be an increase in quality if the *salai* is removed."

Having limited experience myself I'm afraid I am not in a position to give a general answer to this question, and would like to know, from anyone with experience on this subject, "Whether the change thus made in the factors of the locality (by the removal of the *salai*) is liable to deteriorate the quality of the young teak or not."

I would like to add one word in conclusion and that is about the actual method employed in removing the offenders. Many prefer girdling the *salai*. Personally I have found that felling the whole tree (or hacking off an offending branch or two) is to be preferred. This may incur a very small extra expenditure but I believe the extra expenditure incurred is justifiable: because of the following reasons :—

(1) If the forest guard supervising is energetic the *salai* is girdled too deep. A strong breeze comes along, the *salai* breaks and falls causing a lot of damage at times.

(2) Any damage done by actual felling at first can be remedied to a certian extent.

(3) If the forest guard is lazy the *salai* only laughs at its persecutors. The happy mean is seldom found—

more especially in places where new labour is employed every year.

A. J. ROBINSON, P. F. S.,
Central Provinces.

INOCULATION OF CHIR (PINUS LONGIFOLIA) WITH COLEOSPORIUM CAMPANULAE (PERS.) LEV., ON CAMPANULA CANESCENS, WALL, AND COLEOSPORIUM INULAE (KUNZE) ED. FISH., ON INULA CAPPA D. C.

Peridermium complanatum Barc, is a very common rust on the needles of *chir* (*Pinus longifolia*) in the Himalayas. It has been fully described by Barclay* in 1890 and so it is not necessary to deal with it from a morphological point of view. This note includes simply the results of inoculations which have been carried out at Dehra Dun.

The fungus was first observed in Dehra Dun by Mr. R. N. Parker in April 1922 and since then it has been appearing every year. In 1924 the attack was so severe and widespread that almost every tree, whether cultivated or in its natural habitat, was literally covered with the pustules. This naturally attracted attention with regard to its alternate stage and a search was accordingly instituted for it which extended over a period of three years. In the gardens where the host grows under horticultural conditions no fungus of importance was found which could be connected with it but in the local forests, particularly on the slopes and at the foot of the Siwaliks *Coleosporium campanulae* (Pers.) Lév., on *Campanula canescens* was abundant in grassy areas and on the banks of small ravines. Working on the analogy of *Coleosporium Senecionis* (Pers.) Lév., which represents the teleuto-stage of *Peridermium acicolum* in foreign countries and on the general belief that the leaf-inhabiting Peridermia are usually connected with fungus like Coleosporium and supported by the fact that in the Siwaliks *C. campanulae* was fairly common in the

*Barclay. A.—Descriptive List of Ured. in the neighbourhood of Simla, No. 2, 1890, pp. 101-102.

pine forests an attempt was made to infect them with this organism. In March 1924, 30 inoculations were made with germinating uredospores by and without causing wounds. A little later when the teleutospores developed, a separate series of inoculations was conducted in the same way but all of them remained unsuccessful. The experiment was repeated again in 1925 and 1926 and confirmed the previous results. Not a single needle showed the slightest sign of penetration either externally or microscopically.

C. campanulae appears in Dehra about the beginning of March and entirely disappears by the end of June when the host dies away. It has, therefore, not been possible to try inoculations at other times of the year. Another important point regarding it is the germination of spores. After March I have never succeeded in germinating them although various methods were used. Barclay * also seemed to have experienced a similar difficulty in Simla in dealing with them.

In October 1926, Mr. H. G. Champion, handed over to me specimens of *Inula Cappa* which were received from Naini Tal. These contained uredo spores of *Coleosporium Innulae* (Kunze) Ed. Fish, which is said to be extremely common up there. On account of its close association with *P. complanatum* which is equally plentiful at Naini Tal it was proposed to inoculate some pine needles with this also with a view to determining the genetic relation, if any. After several periodical germination tests 40 inoculations were made on 30th November when the highest percentage of germination was obtained. Simultaneously and in addition to the above, 12 inoculations were made on the leaves of *Inula Cappa* itself as a check on those of pine. Six of these were made on the under surface which is heavily clothed with a dense growth of hair and six on the upper comparitively smoother surface. Separate plants were used for each kind of inoculation. Natural infection was not anticipated as this host appears to be absolutely immune to all kinds of fungus attacks much less *C. Inulae* which does not at all occur in Dehra Dun.

After a period of three months and eight days the *Inula* leaves which were inoculated on the under surface, began showing

*Barclay, A.—loc. cit. p. 91.

signs of infection. First of all a yellow discolouration was produced on the inoculated spot which soon gave rise to a cluster of uredo sori on the under surface. By April 7th the fungus had attained its maximum growth and the leaves commenced withering. The other inoculations did not seem to have taken but towards the close of the experiment a few isolated pustules were seen on some leaves which looked like sporadic infections conveyed from the successful inoculations all of which were very near each other within a small enclosure. Outside the fencing and nowhere in the forest, did the *Innulas* have any rust at all. As regards the pine inoculations all completely failed although they were kept under observation till the end of fall season.

These results seem to indicate that *C. campanulae* and *C. Inulae* are not connected with *P. complanatum* in spite of the fact that they are extremely common in pine areas in Dehra Dun and Naini Tal respectively.

Field observations, although not very conclusive, yet tend to support this view to a certain degree.

In 1924, as has been stated already, *P. complanatum* and *C. campanulae* were extremely abundant in Dehra Dun and it looked as if they were linked together but during the following two years the former was much less whereas the latter continued to be as plentiful as ever. In 1927 both fungi were rather scanty as compared to other years. This irregularity of growth cannot possibly indicate a biologic relation between them, in fact it may prove the reverse. Further work is being continued.

The writer's thanks are due to Mr. P. C. Kanjilal, Deputy Conservator of Forests, for sending a nice series of *Inula Cappa* specimens from Naini Tal.

DEHRA DUN: } A. HAFIZ KHAN,

16th November 1927. } *Assistant to Forest Mycologist.*

MANUAL OF FOREST ENGINEERING AND EXTRACTION.

By J. F. Stewart.

(*Messrs. Chapman and Hall, London, 15/-net.*)

The author claims that the special object of the book is to show how much construction work is necessary in logging and other forest operations with unskilled labour and with the materials available at site. This object has to a certain extent been achieved as the book is written from the practical standpoint but more detail ought to have been included and some problems discussed theoretically if the book is to prove of real value particularly to the man with limited Engineering knowledge. For instance the handling of heavy spars might well be included in the chapter on trestles, particulars of light railway plant added to that on forest railways, and a few simple calculations to determine the strength of road bearers or stringers introduced. Some tables of breaking loads and safe working stresses and a few more working diagrams and dimensioned sketches might have been inserted. The excellent set of photographs could be improved with an explanatory note under each. As the author points out "it is quite impossible in a written work to lay down dogmatically the method which should be adopted in any particular case" and the forest officer or exploitation officer must necessarily decide for himself what system to adopt bearing in mind local conditions. This decision is, of course, materially helped by experience but the Manual makes some suggestions and shows

how to carry them out. This simple text-book which appears to be a general summary of logging methods as practised chiefly in Canada and the U. S. A. should, therefore, be of assistance to those engaged in timber exploitation. As regards the Forest officer in India there is much to interest him in the manual, especially in the chapters which deal with slides, chutes, flumes, logging roads, tramways, trestles, booms, dams, various types of bridges and portable saw mills.

Modern methods of extraction by means of tractors in Madras and a skidder in Bengal are being tried, ropeways in the hills and tramways in the United Provinces and the Punjab have been introduced for some time, but as labour and forest conditions are so very different from those in the Western world, modification of the western logging methods described is necessary to suit conditions here in India.

INDIAN FOREST RECORDS (ENTOMOLOGICAL SERIES), Vol. XIII, Part II, 1927, Price Re. 1-4-0.

(OBTAINABLE FROM THE GOVERNMENT OF INDIA CENTRAL PUBLICATION BRANCH, CALCUTTA.)

This Record from the pen of Mr. J. C. M. Gardner consists of two parts, of which the first forms a third contribution from the Forest Research Institute on the subject of the identification of the earlier stages of Indian *Cerambycidæ* (longicorn), the data of the first two papers being also incorporated.

Over 30 species are dealt with, original descriptions of the larvæ and in many cases of the ova and pupæ also being given, with biological notes. All essential points are illustrated in the four plates. The list includes several species very well known in the adult stage such as *Dihammus cervinus*, so troublesome in young teak plantations, the common *Stromatium barbatum*, and numerous borers of the hill conifers. The list of host plants includes most of the chief trees of India—teak, sal, deodar, blue pine, *babul* (*Acacia arabica*), *chir*, (*Pinus longifolia*), and walnut,—as well as bamboo, and the Record will be a most useful aid to the recognition of many common timber tree pests without the

lengthy and often uncertain process of breeding out the adult stages. At the same time it is a valuable contribution to our general knowledge of the systematics of immature stages of longicorn beetles. Incidentally it reminds one of the enormous field still remaining for work in this direction.

Part II consists of descriptions of the larvæ of three species of *Carabidæ*. One of them belongs to the genus *Calosoma* well known for its assistance in checking multiplication of defoliating caterpillars—the species in question preying on deodar defoliators. The second is a teak defoliator.

FAUNA OF BRITISH INDIA—BIRDS, VOL. IV.

(SECOND EDITION.)

BY E. C. STUART BAKER.

The first three volumes of this work completed the Passeres (including the broad bills which were not considered passerine in the original edition). The present volume begins the non-passerine birds and carries us up to the end of Vol. III of the old edition with the exception of the birds of prey.

An interesting feature of this volume is the phylogenetic tree of the Pico-Passeres on P. VIII. It shows the probable growth of the sub-orders and families dealt with up to the end of this volume. This whets the appetite for more and we hope that a similar tree for all birds may appear in a subsequent instalment. Those of us who are ignorant of this aspect of the subject are left rather in suspense as to how the remaining orders fit into the scheme, in particular, the relationship between the owls, which appear in this tree, and the birds of prey which do not.

A very strong point about the new edition is the much fuller account of the habits and life history of each species much of it the result of direct observation by the author.

The coloured plates are, we think, better than ever in this volume; those representing the Burmese Pigmy Woodpecker and the Western Collared Pigmy Owlet are particularly good. The

latter plate (as also that of the Eastern Collared Pigmy Owlet) shows two individuals illustrating the extreme phases of colouration in the same species—perhaps the most useful purpose to which coloured plates can be put.

EXTRACTS.

VIRGIN FORESTS OF MONTENEGRO.

Of the undeveloped provinces of Yugo-Slavia, Montenegro seems to be the most in need of technical knowledge and capital for the exploitation of its resources, especially its forests, which cover an area of 532,796 hectares, or as much as 40 per cent. of the whole area. With a view to making known the forest wealth of Montenegro, a valuable survey has recently been made by Professor Alexis Sensin, of Belgrade, from which it appears that the forest percentage of the province is very nearly that of Finland (45 per cent, as compared with 48 per cent.), and if there is added the fact that Montenegro has purely forest soil, it seems certain that future prosperity will depend primarily on the organization and management of the forests, their rational exploitation, and the introduction of modern forestry.

Experiments made by the Yugo-Slavian Ministry of Forests prove that a large section of copse, which covers an area of about 60,000 hectares, could be converted into tall forest, also that land where pasturage is prohibited for some length of time, very easily changes into forest. Considering all the success of work undertaken during the last few years, it is hoped that large stretches of land, which at present bring in nothing or next to nothing, will easily become productive and contribute to the general enrichment of the country.

Predominance of Beech.—Montenegro is one of the richest provinces of Yugo-Slavia in lofty trees, and inasmuch as it is in close proximity to the sea, there seems every chance of a successful timber industry and the exportation of wood and its products developing. In the mountain areas the beech predominates: lower, the principal trees are varieties of oak (*Quercus sessiliflora*

and *Q. Cerris*), while in the valleys where the climate is more temperate, there are the *Quercus Ilex* and *Ailanthus glandulosa.* The greater part of the wood is exploited at present entirely without forethought and for the needs of the moment. By purely administrative means, however, order could be introduced, and a much larger quantity of timber obtained than at present. The lofty trees occupy an area of 273,000 hectares, and according to the Ministry of Forests, 171,000 hectares, or 62 per cent. are over 80 years of age, while the rest are younger. During his travels in Montenegro, Prof. Sensin saw a great number of lofty forests containing a large quantity of mature wood varying from 50 cubic metre to 300 cubic metres per hectare, and he considers that the felling of a large number of venerable trees is absolutely necessary from a forestry point of view.

Numerous Mature Trees.—Of the stock of wood in the older forests, Prof. Sensin states, that in his journeys through 50,000 hectares of this area, he found the average of the great majority of trees was 180 years to 200 years. Quite often more, and it was rare to find stretches of lofty trees 100 years old. Most of these forests are on the slopes of hills and mountains, and the chief tree is the beech, which forms stretches by itself, or else is mingled with the silver fir, Norwegian pine, mountain maple and other species. Most of these trees have diameters of 30 cm. to 60 cm. at the height of a man, though many are to be found with a diameter 100 cm. and even more. Their height varies in general from 20 metres to 30 metres, while in special cases it reaches 40 metres. The beech should form about 57 per cent. to 60 per cent. of the total cubical content of the virgin forests of Montenegro.

Silver Fir and Pines.—After beech the most frequent trees are the Norwegian pine and silver fir, the former growing especially in the north-west of the country. These two trees together form nearly 30 per cent. of the total cubical content of the virgin forests. The third place, with 7 to 10 per cent. belongs to the various species of pine, of which the most common is the black pine (*Pinus Laricio*). Then there is the common pine, and also two varieties peculiar to Balkan flora *viz.*, *Pinus Leucodermis*

(Pancerkiefer) and *Pinus peuce.* The first two trees, *Pinus Laricio* and *Pinus Leucodermis* have heavy wood with a very fine grain, which is slightly pink in the *Pinus Leucodermis*, and very resinous. The heart is large and the quality good. It is very similar to the pitch pine of North America. The wood of the *Pinus peuce* is white, light, not very resinous, and similar to the wood of *Pinus cembra*, and should be very good for the manufacture of furniture cases, etc. Besides the beech, there are also in the virgin forests, other very valuable deciduous trees, such as the mountain apple, the ash, the elm, the oak, the walnut, and the mountain sycamore, which is the most prized. All these, however, do not form more than 2 per cent. to 3 per cent. of the cubical contents of the virgin forests.

Stock of the Ripe Timber.—It is estimated by Professor Sensin that the total stock of the old forest plantations, plus the ripe wood among the younger forests, makes an approximate stock of 74,000,000 cubic metres of timber in Montenegro, ready for the axe. This figure pertains only to Montenegro proper, and does not include the four other districts forming the province of Zeta. The only need for the exploitation of these resources is the construction of cheap railways. The exploitation and export of the timber could then be carried on in three directions. First, in the north west, where the wood could be floated down the rivers Piva and Tara to the stations on the Uzice-Sarajevo line, or else down the river Sava to Belgrade; second, the wood from the southern forests could be transported to the Lake of Scutari, and thence by water to the sea; third, the timber from the remaining forests could be exported from the Bay of Cattaro.

[*The Timber News, No. 1771.*]

AFRICAN GAME RESERVES.

Of all the problems that engage the attention of the administration of British Africa, none more urgently requires a solution than that presented by the tsetse flies. It is a subject which cannot be discussed without a certain amount of technical phraseology, though the solution which is from time to time suggested has in fact nothing scientific about it. There are then, at letas

nineteen species of the genus *Glossina,* all known as tsetse flies, and all subsisting in the winged state on the blood of living animals. In drawing blood from a victim through the sharp proboscis they also draw a supply of microscopic parasites. The parasites which have made tsetse flies a menace to Africa are the trypanosomes of the "nagana" disease of wild game and stock and of at least two kinds of human sleeping sickness. Infection seldom happens directly, but the trypanosomes imbibed by the fly pass through a phase of their existence in the organs of the tsetse and after an interval of time render its bite infective. Trypanosomes are all much alike in their microscopic appearance, and in the earlier stages of investigation it was believed that wild game, tolerant of their presence, formed a permanent reservoir from which tsetses could convey "nagana" to domestic stock and sleeping sickness to man. The natural inference was that the game must be destroyed. Research, however, has shown quite definitely that the diseases and their parasites are distinct, and that each affects, preferentially if not exclusively, distinct species of tsetse with different habits and distribution. The heroic measure of exterminating game can no longer be regarded as either necessary or effective. But it is still supported, and, in a letter which we publish to-day, a well-informed correspondent—referring to the threats against the Transvaal Game Reserve—points out how strongly such demands can be reinforced by the material interests of land speculators and biltong hunters.

The contention that to preserve game is to preserve tsetse has an appearance of reasonableness which has gained it some support. Logically there is much to be said for the breaking of a link in the chain of infection, and the disappearance of tsetse which followed the destruction of game in parts of the Transvaal is quoted as proof that big game are such a link. But there is no more dangerous logical fallacy than "post hoc ergo propter hoc." There are parts of Africa where, for all that the game have vanished, cattle still die off from fly disease. A valuable pamphlet issued by the Society for the Preservation of the Fauna of the Empire even states that in one area in Tanganyika Territory the expert investigators of a deadly outbreak of sleeping sickness reported that it possibly resulted from game destruction

which "diverted the fly to man." This explanation of a particular outbreak has been contested; but the evidence of Dr. Roubaud, the distinguished French investigator, that the most intense infection in the Congo region was associated with the greatest ack of game cannot be disregarded. It would appear, indeed, that any interference with "the balance of Nature" by a wholesale slaughter of game animals might have not merely disappointing but disastrous results. In the present imperfect state of our knowledge as to the association of the tsetse flies with various animals and the widely differing habits of the many kinds of tsetse, cautious progress on several lines seems likely to be more profitable than violent empirical remedies. What seems very certain is that the big game themselves contribute in some degree to the reduction of the tsetse by cropping the brushwood and scrub, in the damp shade of which most of the species of *Glossina* alone flourish. The methodical creation of barriers between human settlements and "fly-belts," which these happily rather sedentary creatures will not cross, by regularly burning and clearing long grass and scrub is a promising line of attack, and all the evidence tends to show that even where the killing of big game is necessary it must be effected with discrimination.

In the case of the Transvaal Game Reserve there is a very strong case against its abolition, and an agitation for its purchase by the Government of the Union is now meeting with some support in enlightened South African circles. At present the Reserve is under the Transvaal Provincial Council, which may give way to farmer-speculators and throw it open, with the certain result of the disappearance of the fauna. The Union Government is being urged to convert it into a national Park, as the Yosemite region has been converted in the United States. It is clear that the disappearance of big game from the greater part of South Africa is an inevitable concomitant of closer settlement, and especially of agricultural settlement. It is clear, too, that big game will be greatly thinned by the growth of population in the tropical Colonies and mandated territories of Africa. But it would be in the highest degree regrettable if the development of Africa involved the loss of the Africa fauna, which, as a distinguished

naturalist has recently pointed out, is "of exceptional interest not only to scientists and sportsmen, but to the entire civilized world and if preserved will be of equal interest to posterity." Game reserves have paid their way in Kenya Colony, and the educational value of national parks can hardly be assessed in terms of money. The extinction of the quagga and the blauwbock in South Africa is a warning of the fate that awaits other harmless and attractive creatures. The last Union Government was anxious to take such measures. The present Government is believed to be waiting only for a lead from scientists and Nature lovers. If they are uncertain of the "practical" value of game preservation, apart from its sporting, sentimental, and scientific attraction, is it not conceivable that the monetary value of the preservation of African big game may be much greater than is commonly supposed? The fact that some of the finest game animals appear to be unaffected by the "nagana" parasite which they carry in their blood suggests that they may eventually supply us with a serum that will immunize domestic stock against disease and throw open the fly-belts to cattle. No one acquainted with the astonishing history of serum-therapy will deny this possibility. And what of the example of America? Having largely destroyed her game, she is now expending large sums to preserve and restore it. She is meeting, moreover, with financial success, seeing that the issue of game licences already produces an annual revenue of more than five million dollars.—[*The Times.*]

CEDARS OF LEBANON.

(A MIGHTY REMNANT.)

Of all the mighty cedar forests which once clothed the grey heights of the Lebanon there survive but a few huddled groups of trees, as the cedars above Ain Zanalta and those above Baruk. But of all these poor survivors there is one grove known above all others as *Al Arz*—the Cedars—the tiny forest of some 400 trees which lies like a small black stain on the bosom of the mountains above the sacred valley of the Qadisha.

These insignificant groves are sole survivors of the fair forests which once spread over the whole Lebanon, and for their disappearance the axe is alone responsible. For centuries and tens of centuries the people of the Lebanon have hacked and sawn and hewn and felled, until not only the cedar but the cypress, oak, poplar, and pine as well have dwindled away. Of all trees the slowly maturing cedar has most suffered. It furnished Hiram and his Phœnicians with the sweet-scented timber which they sold to Solomon and the other kings of the earth for their temples and palaces. The Greek settlers used it, and so did the Romans during their occupation—and so have all races, whether of the soil or foreign to it, which have utilized the resources of the Lebanon. It is only a sentiment approaching to religious awe which has preserved these last stragglers of a vanished host.

There is one guarded spot—the patch above the Qadisha. A wall has been built around the cedars, and the grove is looked upon as a national treasure, a national sanctuary. It is, in fact, the last sacred grove. Most people when they go to the Cedars take the new carriage road from Tripolis. But we preferred to take the old road which, as it climbs up from Shekka on the coast to Haddat, offers some of the finest and wildest scenery in the Lebanon. It runs close to the gorge of the Qadisha. Above, far away, towers the highest peak of the Lebanon, Qommat-as-Sauda, and immediately above, like huge walls erected by Titans, sparsely grown precipices shut in the valley, their sternness softened here and there by terraced vineyards. Ever upward climbs the road until at last the mountain villages of Bsharreh and Ehden are visible on a distant height, with a black spot staining the mountain behind them. That spot is the Cedars.

From Bsharreh to the Cedars it is two hours by mule. We secured ours after the usual altercation as to price. The hire of a mule for the ascent costs 60 Syrian piastres—little more than *2s. 6d.*, and this includes the services of the muleteer, who leads the way and usually beguiles the journey with pipe and song. The long, twisting track up the rocky mountain side is hot and unshaded in summer, and it is well to start early or

choose the late afternoon, which is the better plan if one intends to sleep at the Cedars. And what scenery—what visions of ethereal distances, savage cliffs, falling waters, cloud-crowned mountains, and stony crags! One forgets that one is often unpleasantly close to the side of a precipice, or that the mule, bedizened with scarlet tassels and blue beads, is picking a painful way up a path that resembles the bed of a torrent rather than a track for beasts and men, and is often scarcely wide enough to allow two laden animals to pass. But the Cedars themselves, like Eastern brides, keep hidden till the very last. They lie in the lap of the mountain, and it is only when one is close upon them, after two hours' uphill toiling, that they reveal themselves.

And that remnant of a forest, fenced about with a grey stone wall outside which but a few truants remain, is all. But when one gets closer one sees that it is a mighty remnant after all. As one climbs up over the slippery, sweet-scented needles, layer upon layer deep, into the solemn and ancient wood one realizes that it is enough to evoke all that the words "Cedars of Lebanon" imply. They grow close, these trees, a few of which number their years not in hundreds but in tens of hundreds, and within their shade there is the gloom and hush of a holy place. Some of the veterans have attained an immense size, and five men are needed to encircle one aged trunk with their arms. It is reputed to have seen 2,000 summers and winters. Who knows? It may have seen the birth of Christianity, the first fearful years of the faith and its triumph.

The silence, and the twilight made by the thick branches, and the incense of the sun-warmed, aromatic timber, give the impression that one is in a temple, so that the little Maronite chapel which pious people have built in the centre of the wood seems unnecessary. The chapel bell is hung on the trunk of a cedar tree near by, and once during the day its voice rings out through the wood calling people to prayer.—[*The Times.*]

FOREST GIANTS.

Repairing Early Waste.

When the white man came to the green isles of New Zealand the country's principal crop was forest. Over a considerable por

tion of the rougher land it was the best crop that the soil was ever likely to produce : but that fact was not recognised, and during the last 60 years much purely forest country, as well as country of a real grass value, has been cleared by the agency of steel and flame.

The needless destruction of many millions of feet of accessible indigenous growth has left the timber industry dependent upon surviving forests that are located far inland, or in steep country, or in conditions that make the transportation factor costly. Not only is the transportation factor affected, but the cost of working the bush itself is increased, since many of these tracts that have escaped axe and fire consist of sheer slopes, broken gullies, and stream gorges, where wheel traction is impossible, and where even the operation of a long hauling rope by a steam hauler is arduous and slow. New Zealand is paying the price for having converted Nature's wealth into smoke, and for having wantonly driven the timber industry into the mountains and remoter regions.

Sea carriage is generally cheaper than land carriage. It is understandable, therefore, that North American sawmills, if their transportation cost to their own coast is not high, are able to send timber across the Pacific Ocean at freights that compare favourably with New Zealand land transportation freights, or even with the charges of New Zealand coastal shipping, and are able to undersell this Dominion's timber industry in the coastal cities (the chief market) and sometimes in the inland towns.

FILLING THE GAPS.

When the destroyers at last recognized that a period of remoteness and scarcity, amounting to a threat of timber famine was approaching in the indigenous forest, the planting of exotic trees was taken up in earnest. So tardy had been the realization of the danger that the planting of rapidly maturing trees became necessary if they were to be available before the calculated dates of timber-shortage. The slower-growing indigenous trees therefore did not enter into this undertaking. Natural regeneration of indigenous forests may yet prove profitable—especially with kauri and beech—but the immediate need of the new tree-planting policy was rapidly developing exotics, and of these the ***pinus insignis (radiata)*** won first place because of its early maturity

though more important timbers like Douglas fir (Oregon pine) are also being largely planted.

Both the State Forest Service and the various tree-planting companies are at last alive to the economic importance of finding the right sites for new plantations, so that the timber when matured shall be easily worked and transported to market.

THE FOREST SERVICE.

After the close of the Great War the Forest Service took over most of the Crown's marketable timber areas, and it is regulating the disposal of this indigenous forest to the sawmilling industry. Also it began to develop the planting of exotic trees on afforestation lines, and it claims to have reduced the cost of establishing a plantation to £2 an acre. Its policy is thus based partly on indigenous and partly on exotic development. The Forest Service reports that in 1925-26 the total of Crown indigenous forests dedicated to forest-conservation and tree-cropping was a little over 7½ million acres, equivalent to 11·4 per cent. of the Dominion's area; on the State plantations (exotics) side the area increased from 40,000 acres in 1921 to 80,000 acres this season, and the objective of the Service (apart from private planting) is 300,000 acres in 1935.

The initiation of a really constructive forest policy about ten years ago and the building up of the Forest Service will for ever be associated with the name of the Right Hon. Sir Francis Bell, a Minister who insisted on deeds at a time when forestry was rec iving from politicians little more than lip-service.

For 60 years prior to the last decade the voice of the forest lover—of him who loves the evergreen native bush and its dependent bird life for their exquisite beauty and for their botanic and avian distinction—had been as a voice in the wilderness. The rural realist—bent on substituting grass for trees—and the careless fire-raiser heeded him not. The change in the tide is due to the fact that timber famine has brought economics into line with forest love and to the settler's discovery that on large areas of deforested land his grass will not hold. The realist has been brought face to face with unheeded realities. One result is a realization that large portions of New Zealand are pre-eminently

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tree country—as Nature originally designed—and that if they are not developed in consonance with their own native genus the whole Dominion—whether pastoral, agricultural, or industrial—will be proportionately poorer.—[*The Times.*]

THE OAKS OF BRITAIN.

FACT AND FICTION.

There is much of romance in more senses than one about the oaks of Britain, but, romance apart, the roots of some of the remarkable trees referred to in recent letters to *The Times* undoubtedly go deep down in the history of our country. How deep no one can say with even an approach to accuracy, for these *grands seigneurs* of our parks and woods are in ruins, and so their age cannot be computed by the customary method of counting the rings of growth; moreover two or three centuries or even more may well have passed before the really ancient oaks, now regarded with sentimental respect, were sufficiently noticeable to be singled out from other fine trees which must have been common enough in Britain before our forests were either thinned or stripped, or our estates enclosed.

Like so many other every-day objects of the countryside, they have been taken for granted by generation after generation, and no careful records kept of them, nor any particular respect paid to them. Witness the pair of remarkable trees called Adam and Eve, in Lug Meadows, near Moreton, one of which, when the Shrewsbury and Hereford line was under construction, was converted into a dwelling by navvies. The top of the trunk, which was 8ft. or 9ft. in diameter, was thatched, a fireplace and chimney built in, and a door fitted. When the navvies moved elsewhere the new stationmaster moved in, and no sooner had he quitted his aerial lodging than the place was used as a lamp room. Among scores of other cases of what would now be called vandalism, there is the once famous Greendale oak at Welbeck, the trunk of which was so huge that an opening was hewn through it of sufficient size to allow a coach and four to pass, and, incidentally, to allow the

noble owner of the day to pocket a bet he had made about it. And how many of our historic oaks have not at one time or another seen and felt a fire in the hollow of their trunks?

It is just possible that one or two of the ruined patriarchs may have seen every change that has taken place in our history since the first William landed on our shores, but it is doubtful if there is a single well-preserved oak in Britain in vigorous health which, if felled to-day, would show 600 annual rings.

It is hardly likely that oak trees can ever recover the place they once held in our history. Their principal use for centuries after we became a maritine nation was for shipbuilding, and later on the provision of timber for the Navy became a national concern. In the time of William III an Act was passed to provide for the enclosure and planting with oak of 2,000 acres in the New Forest solely for the use of the Navy. Further, 200 acres were to be enclosed annually for the next 20 years. At the time of the Nepoleonic invasion scare, when ships of war were built as fast as men could build them, the call for oak of the right kind was so great that prices rose to a figure which would tantalize present-day landowners who find oak practically unsaleable. The forestry accounts of the Nunwell estate, on the east side of the Isle of Wight, where the oak is of peculiarly slow growth and much esteemed of old for shipbuilding, show that in 1806, the owner Sir William Oglander, was called upon to supply nearly 170,000 feet of oak, the best timber realizing 4*s*. 11*d*. per foot, and the rest 3*s*. 8*d*. In 1807 the average price had risen to 4*s*. 6*d*. per foot, and next year to 5*s*. 10*d*. But though the demand continued almost insatiable, the supply of oak near the southern yards, at Buckler's Hard and other places, was diminishing, and in 1809 prices rose again to an average of 7*s*. per foot. All the time elm, too, was in demand, the prices rising from 2*s*. 9*d*. per foot in 1807 to 3*s*. 8*d*. at the end of the scare.

Of only slightly less importance was the use of oak in building, and even nowadays it is easy for anyone with an eye for such things to see when one is in an oak country. There can hardly be a cottage of respectable antiquity in Sussex, for instance, into

the construction of which oak has not entered largely, because it was the local wood. Had a soft wood been equally handy it is as likely as not that our predecessors would have used it, as we do. Good oak is none too easy to work, particularly with machine tools, and so in an age when expedition and general convenience count for so much, more easily worked timber has largely ousted oak for all but uses for which it will probably always be retained. Though untenable the tradition that seasoned oak never dies is no doubt fostered by the fact that wood of undoubted age removed from old buildings and put to fresh uses often splits and cracks, and has been known to warp.—[*The Times.*]

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COST OF PLANTATIONS IN NORTHERN BENGAL.

In a recent issue of the *Indian Forester* there was a reference to the cost of plantations in Bengal. It was stated that, when the work was first undertaken, the cost was Rs. 90 an acre. Naturally with experience we have been able to reduce the cost and the following figures may be of interest :—

I have classified the types of plantations in northern Bengal as below :—

A.—Sal *taungya*. Species—Sal on all suitable land with *Bischofia javanica* or *Lagerstrœmia Flos Reginæ* on the low ground (say 5 to 10 per cent. of the area).

B.—Miscellaneous *taungya* in the plains. Species—*Gmelina arborea*, *Chickrassia tabularis*, *Cedrela* spp. *Bischofia javanica* and several other species.

C.—Miscellaneous *taungya* in the hills (5,500 to 7,500 ft. elevation). Species—*Cryptomeria japonica* pure, *Alnus nepalensis* and *Bucklandia populnea* mixed, *Michelia excelsa*, oaks and maple are the most commonly planted.

D.—Miscellaneous *taungya* in the foot-hills. Species—*Terminalia myriocarpa*, *Acrocarpus fraxinifolius*, *Duabanga sonneratioides* and *Chickrassia tabularis* each sown pure in continuous lines six feet apart or *Michelia Champaca* planted six by six are the most usual.

E.—Regular plantations of sal. Species as in A. This is an emergency method when *taungya* cultivators are not procurable. It is seldom necessary nowadays.

F.—Regular plantations of miscellaneous species in the plains. Species as in B. Seldom necessary nowadays.

The figures were arrived at by considering the various operations necessary each year in a number of successful plantations of each type and taking the average cost per acre of each operation. The cost of fencing was computed on the following assumptions :—

(1) That each plantation is a rectangle 350 yards by 560 yards (40 acres about the usual size and shape nowadays).

(2) That each area is kept fenced for not less than four years.

(3) That wire lasts 8 to 10 years with either one or two moves in that time.

(4) That present rates for materials continue in force.

No account has been taken of the value of wet paddy cultivation allowed free to all *taungya* cultivators in type A and to most of those in type B. The average allowance is 5 acres a household and each household does an average of ·7 of an acre of plantation a year. The land is unfit for tree growth but local land revenue on such land outside the forest is about Re. 1-8-0. If this is to be included, therefore, about Rs. 11-8-0 per acre should be added to the cost of A and B.

I have considered the cost of maintenance in each type up to the point at which I estimate that profits from thinnings will balance or exceed their cost on a large scale in average localities. As plantations on a large scale have only been made in northern Bengal during the last ten years, the figures over that age are mere assumptions but the sums involved are not large. We have isolated cases of thinnings showing a profit in eight-year-old plantations both of sal and miscellaneous species but these were favourably placed. I think it is fairly safe to assume that

most thinnings in 20-year-old sal and 12-year-old miscellaneous species will pay their way.

YEAR	TYPE :—A	B	C	D	E	F
	Cost in rupees per acre.					
	Taungya.				Regular.	
1st. Formation and nursery ...	½	2	7½	6	35	39
Fencing ...	6½	6½	...	...	6½	6½
2nd ...	...	...	...	5	13	9
3rd ...	6	3	3½	2*	7	5
4th ...	3	2*	2*	1½	3	2*
5th ...	3*	...	1	...	3*	...
6th ...	1½	1	...	1½	1½	1
7th ...	...	...	1	2*	...	...
8th ...	1½	2*	...	...	1½	2*
9th ...	...	...	...	...	...	...
10th ..	3*	...	2*	...	3*	...
12th ...	1	...	...	...	1	...
15th ...	2*	...	2*	...	2*	...
TOTAL ...	Rs.28	Rs 16½	Rs.19	Rs.18	Rs.76½	Rs.64½

In the plains part of the Kurseong division a system of *taungya* is practised in which the field crops belong to the Forest department, a paid labour-force taking the place of ordinary cultivators. I have not included this type because the figures depend entirely on the success of the field crops and it is difficult to say what constitutes an average season. In the past the seasons which showed the highest profit from field crops often produced the worst plantations, and the best plantations were put out at a loss. Recently two moderate seasons have shown about Rs. 100 revenue against an expenditure of about Rs. 90 per acre with a successful sal plantation in each case. If

*Thinning.

this can be maintained the system would about hold its own with type A as the ten rupees profit would about cover the cost of tending in the second year which ordinarily is done free by the cultivators with their second year's crop, but it is still in the experimental stage and only employed where unhealthy conditions and lack of wet cultivation make the tract unpopular with forest villagers of the usual type.

The cost per acre shows a tendency to diminish gradually as we and our villagers gain experience, and the area we put out each year increases. New methods are experimented with and, if found successful, standardized—thus *Tephrosia candida* sown between the sal lines, after some years of trial, has just become the practice in all sal sowings and may reduce the cost per acre of type A by a rupee or two.

DARJEELING: *1st February* 1928.

E. O. SHEBBEARE, I.F.S.,
Conservator of Forests, Bengal.

THE DEFOLIATION OF TEAK.

In no country where the control of forest insect pests is seriously attempted has a satisfactory remedy for the periodic outbreaks of fatally defoliating caterpillars been devised, either by forest officers or by entomologists.

The more candid advocates of forest protection admit this, and if further evidence were required it is available in the extensive experiments in methods of dusting forests with insecticides from aeroplanes which followed on the close of the great war. In forests where defoliation is not necessarily fatal, palliative measures are either costly or feeble, and the pest is regarded as an unavoidable evil.

The modern tendency is to place more faith in the so-called biological methods of prevention than in the direct technical remedies.

The economic results of the defoliation of teak plantations in India have been expressed by competent officers as equivalent to the loss of one-half of the increment or somewhere between

$1\frac{1}{2}$ annas and 2 rupees per acre per annum; but as they are not fatal there has been no stimulus to avoid them.

It has been customary in the past to refer the wholesale consumption of teak leaves to *Hybloea puera* while skeletonisation has been considered the characteristic of *Hapalia* (Pyrausta) *machaeralis*. That this convenient generalisation must be abandoned was pointed out in a recent article (*Indian Forester*, April 1926, pp. 143—146) where types of skeletonisation perforation and ragging due to numerous species of insects were illustrated. The defoliation of teak is the result of a complex association of caterpillars, beetles and grasshoppers, which are listed below. The list is formidable, but is intentionally given to show the extent of the investigation now in progress under this head.

1. CATERPILLARS—

(*a*) *Hyblæa puera* (Noctuidæ) and *Hapalia machæralis* (Pyralidæ) are the chief agents throughout India and Burma of epidemic or large scale stripping and skeletonisation.

(*b*) *Diacrisia obliqua* var. *confusa* (Arctiidæ), a general feeder, frequently defoliates teak in the absence of the two foregoing species.

(*c*) Geometridæ : *Hyposidra successaria* and *Hyposidra talaca*, *Boarmia infixaria*, *Cleora alienaria*, *Ectropis bhurmita*, *Orsonoba clelia*.

Sphingidæ : *Acherontia lachesis*, *Psilogramma menephron*.
Lymantriidæ : *Dasychira mendosa*, *Orgyia postica*.
Eupterotidæ : *Eupterote* sp.
Pyralidæ : *Dichocrocis nelusalis*.
Species in this group have alternate food-plants and are only occasional defoliators of teak.

2. BEETLES—

(*a*) Chafers : *Autoserica insanabilis*, *Apogonia clypeata*, *A. granum* and *A. nigricans*, *Holotrichia tuberculipennis* and other undetermined species (Melolonthidæ); *Adoretus epipleuralis* (Rutelidæ).

(*b*) Weevils: *Astycus aurovittatus* and *A lateralis*, *Cyrtepistomus pannosus*, *Myllocerus viridanus* and *Myllocerus discolor variegatus*, *Phytoscaphus virgatus*, *Sympiezomias beesoni* (Curculionidæ).

(*c*) Leaf beetles: *Colasposoma asperatum*, *Diapromorpha turcica* and other unidentified species (Chrysomelidæ).

Cockchafers are capable of doing as much damage to individual trees as are the caterpillars, but are locally restricted and abundant only during the rains. Weevils and chrysomelids are responsible for the perforation and marginal ragging of teak leaves.

3. GRASSHOPPERS.—

Acridiidæ: *Aulacobothrus luteipes*, *Aularches miliaris*, *Catantops innotabile*, *Catantops pinguis*, *Cyrtacanthacris tartarica*, *Eucoptera saturata*, *Euprepocnemis alacris*, *Pachyacris venosa*, *Pirithous ramachandrai*, *Spathosternum prasiniferum*, *Phlæoba* sp., *Teratodes monticollis*, *Trilophdia* sp.

Tettigoniidæ: *Conocephalus maculatus*, *Ducetiathymifolia*.

Aularches and other species of grasshoppers appear to rank in importance with the cockchafers. In itself the defoliation by groups 2 and 3 may be classed as tolerable, but, as will be shown later, it has an important bearing on that of the primary pests.

LIFE CYCLES.

The seasonal development of the teak defoliators, that is, the sequence of separate life-cycles through the year, has been studied in field-insectaries established at Nilambur, Madras, at Rahatgaon, Hosangabad, C. P. and at Dehra Dun.

For *puera* and *machaeralis* the life-cycle is of less than a month's duration. A continuous series of 13 to 15 broods per annum is normal in South India with no resting period in the hot weather or in the winter. In the Central Provinces the number of broods is somewhat reduced owing to æstivation in the hot weather and slowing down in the cold weather. In North West India there is a definite hibernation during the winter (*puera*

as moth, and *machaeralis* as larva). The rains produce unfavourable conditions for multiplication, and other factors being equal, the numbers of these two species are then automatically reduced.

The other species of caterpillars have annual life-cycles or at most five generations per annum; their seasonal abundance is at present imperfectly known.

The life-cycles of the beetles and grasshoppers are also long and their periodic appearance is irregular.

Variations in the Periodic Occurrence and Intensity of Defoliation.

The possibility of the occurrence of defoliation by a given species at a given time of the year depends mainly on the climatic factor, but the actual occurrence of defoliation and its intensity at a possible time of year depends on a variety of factors biological and otherwise. Hence the great variability in the distribution and intensity of defoliation in different parts of the forest at one and the same time of year. In order to obtain a more accurate picture of this well-known phenomenon a special officer has been maintained by the Forest Department of Madras to patrol the Nilambur plantations systematically and to record the distribution and grade of defoliation from month to month throughout the year. More or less continuous records have been obtained from August 1926, which have been interpreted and transferred to maps at Dehra Dun. These already give interesting indications of the natural genesis and development of epidemics and promise to explain the relative susceptibilities of localities and age-classes. The great local fluctuations in the grade of defoliation and the effect of the time-factor are best illustrated by the following concrete examples than by attempted generalisations.

Case 1.—Karumpoya-Nellicutta.

Total area of plantations about 1,990 acres.

In *August* 1926 (5th—12th) this group of plantations showed scattered patches of light defoliation covering about one-third of the total plantation area; there were also five centres or incipient areas of heavy defoliation.

In *September* (2nd—8th) the lightly defoliated area had decreased to about one-fifth of the total; the centres of heavy defoliation had died out and were replaced elsewhere by three new ones.

In *October* (30th September—7th October) a resumption of defoliation was observed; about half the total area was lightly defoliated, the extent of heavy defoliation had much increased (exceeding that in August), and four centres of complete stripping had appeared.

In *November* (4th—11th) the lightly defoliated areas broke up and were reduced to about one-third of the forest; the heavily defoliated portions similarly decreased in extent and were restricted to numerous isolated spots; there was no complete stripping. The conditions were such as to lead one to conclude that the epidemic had failed and was on the point of dying out.

In *December* (30th November—2nd December), *i.e.*, three weeks later, the whole area was completely stripped.

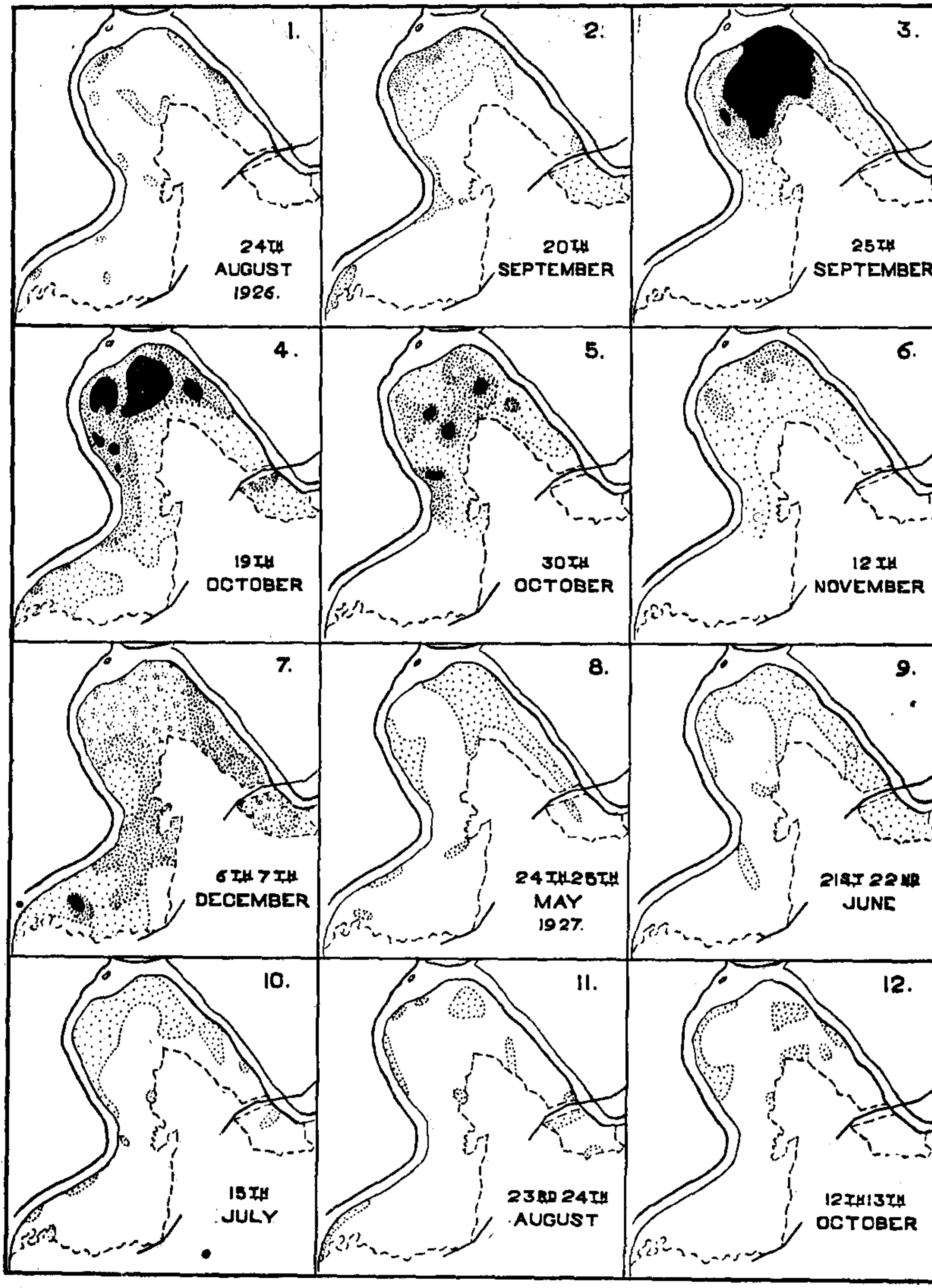
CASE 2.—CHATOMBORAI, PANNENGODE, VALUVASSERI, ETC.

Total area of plantations about 2,080 acres.

In *August* 1926 (24th—28th) the patrol discovered several patches of moderate extent and two larger areas lightly defoliated.

In *September* (18th—24th) a slight extension of the light defoliation had occurred in some places and was dying out in others; in the 600 acre block, Pannengode, (see maps, Plate 16.) The intensity of defoliation is shown by the depth of stippling, (solid black-complete stripping) a centre of heavy defoliation observed on the 20th September (fig. 2) had largely extended and become completely stripped by the 25th September (fig. 3).

In *October* (19th—25th) the area of light defoliation was much extended to about one-thirds of the total plantation area; there were also two large stretches of heavy defoliation which included three main foci of complete stripping. Pannengode on the 19th October, (*i.e.*, 24 days after the previous observation) showed an extension of the total area of heavy defoliation, but a reduction in the abundance of defoliators in the previously stripped portions and a shifting to new centres of complete stripping (fig. 4). By the



J. B. SINGH DEL.

THE DEFOLIATION OF TEAK.

Intensity of defoliation in Pannengode, Nilambur, Madras (600 acres), 1926—7.

Black = complete stripping ; white = no defoliation.

30th October this heavy attack had broken up into isolated patches (fig. 5).

On *November* 12th in Pannengode the epidemic had completely died out and was replaced by light defoliation of the remaining foliage and new flush (fig. 6).

In *December* (6th—10th) there was a reduction in the area affected by light defoliation in the north and a new extension in the south; the centres of complete stripping had died out although the surrounding zones of heavy defoliation were largely extended.

The subsequent course of defoliation in Pannengode is shown in figs. 8—12. From May to October 1927 this area was only lightly defoliated in scattered patches of small extent.

CONTROL MEASURES.

Measures for the control of teak defoliators may be based on two distinct objectives; on the one hand, to reduce the frequency of or to prevent extensive epidemics, and, on the other hand, to restrict the damage when the epidemic or complete stripping stage has been reached.

The latter case can be discussed from the theoretical standpoint only, as no opportunity for practical tests has arisen because no wholesale stripping or even an incipient epidemic has occurred while the entomological field-parties were working. Bearing in mind that the complete life-cycle of *puera* or *machæralis* lasts only four weeks and that an epidemic may develop and reach its climax in the course of two feeding periods, *i.e.*, three weeks, it is evident that unusually specialised measures are required. The recognition of an imminent epidemic, the delimitation of the affected areas, the decision to fight, and the organisation of labour and material require action comparable in promptness to that demanded by a forest fire. The occurrence of all stages of the pest (caterpillar, pupa and moth) at the same time, and moreover present in the crown, the undergrowth and on the ground requires a remedy of manifold efficacy. Fire suggests itself for the older plantations and for the dry weather; a contact

and atmospheric poison such as calcium cyanide dust for young stands and the moister season.

But if measures of this nature cannot be converted into fool-proof rule-of-thumb remedies there is little hope of dealing directly with teak defoliators in the epidemic stage. Under present conditions of forest management this possibility is very remote.

Attention is, therefore, being concentrated on a control policy which aims at the prevention of or reduction in the frequency of epidemic climaxes to the normal fluctuations in the pest's numbers.

NATURAL CONTROL FACTORS.

The following account illustrates the importance of some of the natural factors (food-supply, parasites and predators, and climate) that affect the abundance of the caterpillar pests, and the directions in which they can be turned to practical advantage.

FOOD SUPPLY.—Starting with the leaf-fall of teak we have a period of no food, which results in a great reduction and local extermination of the larvæ. The pupal stage (of *puera* or *machæralis*) plus the early moth stage occupies two to three weeks; this period is therefore sufficient to break the continuity of the broods. These species tide over the leafless period on (*a*) adventitious growth of teak (early flush, coppice shoots, etc.,) and on (*b*) alternate food-plants, (*e.g.*, *puera* on *Vitex Negundo* and some *Bignoniaceæ*). The longer the leafless period the more efficient the reduction in the numbers of the pests. Artificial assistance may be given by suppressing the early production of foliage from coppice, epicormics, etc.; and by not growing teak in sites where it flushes in advance of or after the average date for the locality; and by destroying alternate food-plants.

During the growing-period of teak new foliage, comprising brown leaves (with red sap) and soft green expanding leaves, is constantly present. These are essential to the newly hatched larvæ of *puera* which cannot survive on the tougher leaves. It is, therefore, more advantageous that each season the canopy should develop and close up rapidly, than that the production of foliage should extend over a long period (say three months).

Foliage such as epicormics, stool shoots, advance growth, etc., not essential to the volume increment of the stand or the proper growth of the individual tree is undesirable in that it provides extra food-material for the young larva. It is perhaps premature to put forward the slogan "Defoliation produces epicormics and epicormics produce defoliation," but heavy defoliation by opening out the canopy and stimulating further growth of epicormics on the bole, if not in the crown also, ofters facilities for further defoliation. Complete stripping of the stand over a wide area on the other hand leads to the local extermination of the defoliators.

The destruction or partial reduction of foliage by the subsidiary species (beetles, grasshoppers), when it stimulates the production of new folliage, favours the multiplication of the primary species. Further investigation may prove this to be serious enough to demand a remedy. At present the subsidiary species must be regarded as tolerable and not susceptible to economic control.

On the other hand the skeletonisation of the older leaves by *machæralis*, *obliqua*, etc., when occurring late in the season and not immediately followed by leaf-shedding may be beneficial by lengthening the period of no food for the short cycled species.

Next to the question of food-supply studies have been made of the controlling effect of climate and natural enemies.

CLIMATE.—A prolonged and rainless hot weather favours defoliation while early intermittent rainfall before the monsoon decimates the defoliators. Caterpillars of *puera* suffer from wilt (a bacterial disease), the spread of which is associated with high atmospheric humidity ; it may also break out when the species feeds on *Vitex*. Although *machæralis* obtains some protection from its silk webbing it suffers from the mechanical effect of rain. Moths of both species are restricted in their activities and oviposition is checked during rainfall. These conditions are magnified in the monsoon proper when caterpillar defoliation is replaced by that of the hardier cockchafers, grasshoppers and weevils.

The effect of temperature on the length of the life-cycle has been mentioned above.

NATURAL ENEMIES.—The investigation of the natural enemies of the caterpillars (parasites, predaceous insects and animals, gordiid worms) has revealed the existence of an intricate system of controlling agencies which dominate the climatic factors.

(*a*) The predaceous enemies of ***puera*** and ***machæralis*** include (*a*) ground-beetles, *e.g.*, *Calleida splendidula* var. *rubricata* and *Calleida* sp., *Parena rubripicta, Phlœodromius nigrolineatus* and *Phlœodromius* sp., *Styptomerus ruficeps* and other species of Carabidæ; (*b*) ants, *e.g.*, *Dicamma vagans*, *Solenopsis geminata*, and other Formicidæ; (*c*) bugs, *e.g.*, *Canthecona furcellata*, *Sphedarolestes* sp.; (*d*) 3 species of mantidæ, 1 of mantispinæ and 3 of Chrysopinæ; (*e*) a species of Syrphidæ; (*f*) a large number of spiders; and (*g*) lizards and birds.

The predators form a more or less stable factor. Teak defoliators are only a part of their food-supply and their life-histories are independent of those of the defoliators. When the defoliators increase abnormally the checking effect of the predators is correspondingly decreased. In spite of the spectacular appearance of crows, mynahs, etc., in defoliated plantations the assistance obtainable by artificially increasing the abundance of predators is not likely to be high, except in the case of ants in regeneration areas and very young plantations, and in the case of purely insectivorous birds (on the lines suggested by Mr. Mackenzie in the *Indian Forester* for August 1921 pp. 309—317).

(*b*) The parasites (chalcids, braconids, ichneumonids, tachinids, etc.), on the other hand are more closely specific and their checking action is definitely facultative. Their life-cycles are determined by those of their hosts and when the latter increase in numbers a relative increase in the parasite population follows. Hence it is desirable to create conditions which will maintain a permanent reserve of parasites. These may be reached by discovering and propagating the alternate hosts of the parasites that are not monospecific; propagation can be affected by introducing or favouring those plants on which the hosts of the parasites feed.

The parasite fauna has been studied at Nilambur, Rahatgaon and Dehra Dun and the results are shown in tabular form below :—

Numbers of species of parasites.

—	On Puera.					On Machæralis.				
	Tachinidæ.	Braconidæ.	Ichneumonidæ.	Chalcidæ.	Total per locality.	Tachinidæ.	Braconidæ.	Ichneumonidæ.	Chalcidæ.	Total per locality.
Nilambur ..	3	...	1	1	5	1	3	3	1	8
Rahatgaon ..	2	1	...	1	4	6	9	4	1	20
Dehra Dun ...	1	5	2	1	9	...	4	2	2	8
Total species per family.	5	5	3	2	15	6	12	9	4	31

From the three localities 15 species parasitic on *puera* and 31 species parasitic on *machæralis* are known. A few additional species have been discovered in other regions. Of the above only four species parasitic on *puera* and three species parasitic on *machæralis* are known to be common to two or more regions. If the remaining species are veritably absent in certain localities their introduction is indicated in order to complete the cycle of parasitism.

These parasites are themselves subject to parasitism and on them 22 hyperparasites have been discovered (21 Chalcidæ and 1 Ichneumonidæ); one species of *Apanteles* a widely distributed parasite of *machæralis* has no fewer than 10 hyperparasites. The census of the parasite fauna will be extended to other localities within the habitat of teak with the object of determining the geographical distribution, and discovering other species that can be interchanged. The insect fauna of teak in Burma contains many elements that are absent from the peninsula of India, and may be expected to yield a further series of effective parasites of *puera* and *machæralis*.

ALTERNATE HOSTS OF PARASITES.

Concurrently the parasitism of the commonest species of caterpillars on plants associated with teak has received attention. So far only one or two species of parasites are known to have other hosts than the teak-eating caterpillars, and these parasites are widespread, polyphagous. and subject to heavy hyperparasitism. The ideal type of which we are in search is one that attacks the defoliator of a shrub or tree suitable for introduction into teak plantations as an underwood or along roads, paths and river banks; and one, moreover, that will find its alternate host available at a time when the incidence of *puera* or *machæralis* is reduced to the minimum.

It is unlikely under the forestry conditions in India that parasites can be bred up in a field-insectary and liberated as required, but the maintenance of the supply automatically in a natural parasite reserve is within the bounds of practical silviculture.

LOSS OF INCREMENT.

To measure the absolute loss of increment directly assignable to defoliation is no easy matter in a teak crop where partial or complete stripping may occur at different periods in the growing-season and may be repeated with or without the production of a new flush. The following methods have been tried and abandoned :—(*a*) comparison of the annual rings on cross-sections of trees in even-aged plantations with reference to their past history; (*b*) comparison of the current increment of pairs of trees having the same age, girth, height and general development, one lot protected from defoliation by spraying and a second lot exposed to normal defoliations, and a third lot artificially defoliated by plucking the leaves.

The method now adopted has the disadvantage of slowness, but is likely to give better results in the long run. In some of the already existing statistical sample plots in the Nilambur plantations records of the degree of defoliation are kept monthly for each tree, and appropriate girth measurements are made at longer intervals. In a sufficiently long series of sample trees the variation in the intensity of defoliation is great and may be expected to reveal

its effect in the periodic increment of the individual tree ; provided the period of observation is long enough, and the residual effect of a single defoliation is not prolonged over the whole time-interval between two successive defoliations. This aspect of the problem, however, is not entomological, and I suggest it would be in better hands if taken up by a divisional officer, silviculturist or botanist.

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Forest Entomologist.

SOME ASPECTS OF FORESTRY IN RUSSIA.

By V. Pelts, Formerly Chief of Perovsk Forest District, Sir Darya Province, Turkestan.

The State management of forests has existed in Russia for over two centuries and most of the forests of European Russia are the artificial product of scientific management. The first forest school was established 200 years ago and the present Forest Institute is one of the oldest in the world. Consequently the history of forest development is closely interwoven with the past history of the land and since the geography of Russia in terms of botanical geography and industrial problems is also generally little known abroad it will be necessary to consider them also. Russian export of timber to England alone, 20 years ago, was already valued at 25 million pounds sterling.

Russian conditions are little known and usually misrepresented, adding further difficulties to the discussion of the problems involved. The only fact correctly and definitely known is the large number of illiterate peasants. Some of the doings of the "bear," as for instance the rapid construction of the longest railway in the world, the Trans-Siberian, without foreign machinery, supplies, engineers, or even a foreign loan, occasionally surprise people abroad as being entirely incompatible with the well accepted and most satisfactory theory about the "bears" complete backwardness.

I have been invited to write an article on the forests of Russia with special regard to Central Asia and items of interest

for India and find that it is difficult to tackle the matter without some introduction to this subject in its wider aspects. At the present time forests are nowhere a product of nature alone except in some parts of equatorial Africa, the unaccessible far away districts of Brazil and some of the Arctic wastes of northern Canada and Siberia.

Human influence has affected forests everywhere but it will surprise many people to hear that the forest vegetation of the deserts and mountains of Central Asia has been much more affected and changed by human agency than most of the forests of European Russia surrounded by a dense population. This consideration leads me directly on to the economic aspect of forests. *The distribution of forests, the exploitation of them* and even the very existence of them are often the direct results of the demand for timber for industries or for export*. Up to the great war the possibility of a timber shortage on a world wide scale did not seriously interest practical people. It was known that Russia had vast forests and exported quite enough to cover any shortage in West Europe and nobody was interested to know where the timber came from and how long this satisfactory state of affairs would continue. Across the big water people were in the habit of planning things on a larger scale than in old narrow West Europe. Some talk about the shortage of timber for paper pulp had already been started before the war and the United States of America had talked forestry for some years. The war had one surprising result in Europe: all problems of economics were discussed for the first time in history, reviewed and assessed on a world wide basis and it became known for the first time to the general public how much of any important product was available in the whole world. Till then only the offers in the market had been known to the small circle of people directly interested, the sources and the limits of resources in foreign countries had been an unknown factor. The average Englishman especially had never interested himself much in countries outside the Empire and suddenly he was confronted

* The demand has in many countries exterminated forests but in Russia—the forests being usually Government property – the demand for timber has preserved forests enabling to pay for supervision.

with the surprising fact that the world had become very narrow, distances had vanished and the business man who yesterday was quite contented to know only the limits of the leading markets, was suddenly compelled to readjust his views on a world wide basis. The Frenchman had all along been of a more philosophical frame of mind and interested himself more in things abroad even when they did not concern him—but did not realise that the concrete facts were already at his own door. The German—the citizen of an empire less than 50 years old (except the leading business men)—had not yet got rid of his past, he still continued to think mainly in terms of the local interests of a local principality a few odd miles square. A practical man and an ardent student of book knowledge he knew more of the dry facts about foreign countries than anyone else in Europe—for the sake of knowledge as an object by itself—but lacked the imagination to employ it on problems beyond his home. The Russian—an unknown and obscure figure to West Europe—either quite illiterate or with a vast abstract knowledge, the result of a huge school curriculum including two obligatory foreign languages besides Latin and Greek, either knew nothing or so far as abstract theoretical knowledge went knew more than most West Europeans. However he had been living all along in two worlds. The one world—a world of his dreams—consisted of things abroad somewhere far away in foreign countries where everything was perfect, his other world was the every-day life in his own country, the actual daily realities of life confronting him with hard facts in the shape of persistent government officials who were obviously incompetent, and of business men who could not understand his ideas. The average "intellectual," deliberately disinterested in things practical, never suspected that several industries of his own country, as for instance iron and steel, already exceeded all the needs of the home markets and of a huge railway net covering half Europe and Asia; that many branches of the chemical industry were higher developed than in many foreign countries including pre-war England. He did not know or did not want to know that the cotton mills of Moscow and the sugar factories of south Russia were already working for export to Persia, China and even West Europe, and that the forests of Russia were

already 200 years under the management of experts trained at a Forest Institute. Still less did he like the idea that officialdom was after all not nearly so incompetent as he thought, considering that the taxes did not exceed ten shillings per head of the population. At that low rate of taxation one cannot possibly provide a university trained police man for each street corner in order to satisfy the intellectual. The events of the Japanese war he was very pleased to put down entirely to incompetence and corruption, when in reality the internal agitation produced by the intellectual himself was the real reason preventing the adoption of Kuropat kin's plan to delay serious events till a second pair of rails could be laid along the Trans-Siberian track to enable more troops to be maintained on a war footing in the Far East. The first time he realised that the Government machine was after all much more efficient than he thought was, when he discovered that within a few days the mobilisation of a huge army had been effected, and Germany, Austria and Turkey simultaneously invaded. He had now an opportunity to reflect that to mobilise an army of ten million men and to equip it with supplies required some knowledge and he was thus satisfied for a short time. It was the first time he had ever believed in Government. Up to that time he considered Government superfluous like Count Tolstoi. Of course no one expected the war to last three years and many things happened and gave him again new food for criticism. After Nicolas the Second had been deposed or rather had deposed himself, the Government machinery continued to function outside Petersburg and Moscow for some months as if nothing had happened. As a matter of fact the importance of the court had always been much exaggerated, actual facts showed that all through the war there were at work influences which made Government practically self-contained and usually quite capable of compelling the Czar to comply with the requirements of efficiency even in the matter of appointments, whilst the joint opinion of the army leaders prevailed often in complete disregard of any court influences, even in Petersburg itself. The deposition of the Czar had fatal consequences mainly because a nominal uniting principle disappeared and an opportunity was afforded to the "intellectual," teachers and lawyers,

minor Government servants and proletarians headed by Kerensky to enter the Government; people who could talk and agitate, but had no ability or experience in running any branch of Government business and could never make a united front. The obvious result was that in six months time, of all the parties the only organized force remaining and quite the smallest, the Bolsheviks, turned out the intellectuals by using commonsense, crude force and terrorism, methods very practical as compared with talking, and the intellectual found himself once more back in exactly the same place he had been under the Czar with the slightly uncomfortable difference that whereas formerly he was only prevented from interfering too much with Government work, by such gentle measures as forced emigration from industrial centres, now he was shot at once without any further opportunity of agitating, shot even for the sole offence of talking.

In Siberia and Central Asia things were developing in a healthy way on a large scale, much in the American style; often with the latest up-to-date machinery; very latest agricultural methods; long refrigerator trains bringing butter for export from far Siberia and trainloads of cotton from Central Asia, displacing foreign imports. In European Russia the collision of the practical requirements of statesmanship and abstract sentimental aims could only be solved by the lessons of an earthquake. Russia is a country of many extremes and the sort of information usually supplied by the average run of "intellectual" travelling abroad had not helped to convey to outside people any correct ideas. Whilst for instance an Englishman usually sticks to the idea "English goods are the best" the average Russian intellectual had been all along telling West Europe that everything in Russia was very bad, the reason being that he himself had always been in opposition to Government and all practical and mercantile interests. As a matter of fact the best opinions about several industrial concerns in Russia and even Government services that I have heard were from Englishmen who had been living in Russia. Many were surprised by the equipment of the Moscow Cotton Mills.

West Europeans are baffled when reading about Russia primarily for two important reasons which ought to be always

remembered. West Europe lives in a concrete world, a world of hard practical every-day facts with daily compromises between aspirations and practical possibilities. But East Europe puts its faith in absolute perfection unobtainable practically. It is the outcome of the middle ages and the terrible loss of life in the constant warfare of that period which has educated West Europe to live in a world of compromise. Repeated devastation with up to 50 per cent. decrease of population and similar disasters have never occurred in Russia. A vast country with no internal geographical barriers it has in past centuries never known any man-caused disasters exceeding even a 5 per cent. loss of life. Exact historical research shows that even the hordes of Atilla did not stay in Russia, nor go beyond extracting some small tribute from the local princes. In warfare concerning this tribute only small bands of retainers were involved, the mass of the people remaining unconcerned, and the nomad hordes moving further towards West Europe through the steppes of south Russia, left the bulk of the country unaffected. Serfdom, as known in West Europe, has also never existed and the kind of peasant serfdom often referred to was quite a recent temporary institution existing only for about a century.

Whilst in West Europe serfdom and oppression had existed for centuries till people won freedom by hard struggles and gradually gained political experience, the serfdom in Russia had been introduced by Government after the peasant had been enjoying freedom to such an extent that vast parts of the country were often completely deserted on account of peasant migration ; and to enable the landlords of old to secure some population for their lands it became necessary to prohibit such mass movements. This restriction gradually turned into a kind of serfdom. But it had hardly existed a century when without any struggle by the peasant himself worth mention it was cancelled by a Government edict in consequence of the agitation of progressive landlords. Anarchists who hoped to win followers and benefit by the delay of this measure murdered Czar Alexander the Second not knowing that the edict had been already signed. The murderers well knew that his successor would never sign it. This absence of any hard struggles in the past is the real cause of the absence of any

inclination towards compromise with realities. Very correctly the Slavonic problem has been understood by Professor Masaryk, the President of the new Czecho-Slovak Republic. He says in fact that with the Slav only sentiment counts. A lot of pleasant words do more than any concrete benefits. You can get a Slav to do any hard work, but if you try to treat him the way you can treat an Englishman or a German workman he will revolt at once. Good words are valued by him above good wages or any other practical benefits. It is a matter of sentiment.

This dislike of any practical compromise and the inclination to abstract knowledge are the reasons why everything in Russia is composed of extremes surprising the foreigner. There is no doubt that illiteracy is common, at the same time higher education demands a much larger volume of book knowledge than is required in West Europe. The same can be observed with industries. Those which had a chance are of maximum efficiency so far as perfection of machinery and methods are concerned, for the simple reason that a Russian, if he has the means, will desire perfection, merely for the abstract love of the same, and far beyond any practical usefulness. Hence the equipment and vast size of the leading cotton mills and several chemical factories. On the other hand many concerns fail to make any progress having attempted too much at once when gradual development might have succeeded. In this connection the Englishman is usually mentioned as the man succeeding in work by the practical use of rule of thumb methods. Commonsense and popular wit, has found a way of recording this sort of experience "What is an ideal?" Reply :—"An ideal is a thing that finishes more disgracefully than anything else a man can do. By that you can easily identify it." It leads always to disaster.

There is one thing more that people abroad rarely appreciate, that is truth absolute and relative. One reads daily in the newspapers of how many people have been killed in railway or aeroplane accidents, but seldom of an accident to a horse drawn vehicle : it is so with all information about Russia, if something particularly horrible or abnormal has happened it has surely

occurred either at Timbuktu or in Russia and people are quite satisfied that there such things are quite common, forgetting to remember that the country in question contained in pre-war times nearly 200 millions of population and a vast territory, and that a thing which may be surprising in a West European country of a few miles across does not have the same relative value when it happens within the space of half a continent.

It will not be out of place to say a few words about the forest service in pre-war Russia. This is necessary in order to get a correct idea of the methods of forest management in the past, obviously responsible for the existing forests, and is also in itself of some interest. The present party in power, the Bolsheviks, have preached quite a lot of new theories, especially abroad, but have gradually come to the practical necessity of running the country on some sort of business lines with the surprising result that now from the newspapers it appears that most things are again managed in much the same way as before the war, which leads to the conclusion that the local conditions in every country admit of only one satisfactory method of doing things and not two, and whatever the political creed in power, when it comes to business, methods must be employed suitable to local conditions and founded on past experience. I have no exact information about the present forest service, but I hear that most or many of the former government services are again functioning, so far as work is concerned, as apart from politics. As a matter of fact people often forget that in the present day world it is no longer possible to play with methods of government, and economic factors must be considered by any government desiring to survive even for a few years. The obvious conclusion is, that if not to-day, then to-morrow, the forests will again be managed on much the same lines as before, except that the personnel has of course deteriorated and a pre-war efficiency will probably be restored only in some twenty or more years' time. The heads of government will change, the existing political creed be displaced by some other, but the actual business on the spot in the district is not likely to deviate from old methods except in minor details. Therefore very likely the forest business will, before long, resemble

quite closely both in organisation and in system the forestry of former times such as is described in this article.

The number of forest districts corresponding to districts managed by Divisional Officers in India was somewhere about a thousand. In Turkestan alone there were 33 districts. The Chief of each district had usually two or more assistants with forest institute or equivalent training and Conductors with lower forest school training. The normal assistant could in about five years' time, some time later, get the charge of a district. The Conductor usually remained some 25 to 20 years in the position of an assistant. Lately arrangements had been made for the further training of suitable Conductors, to enable them to obtain the qualifications for earlier promotion.

The higher organisation was in the style of a joint forest and agricultural central office for one or several provinces in European Russia and Siberia with a Chief of that office and so called Revisors under him for inspection of forests. The Revisors were usually themselves acting as Conservators of a forest district besides the duties of inspection in other districts. The Chief of the provincial office was usually either a forest officer or an agricultural officer and had under him also consulting experts on agriculture, hydrotechnics (irrigation) and allied branches. In Turkestan the organisation was somewhat different. The head office was in charge of an officer nearly equal in rank to a governor of a province and he represented the Ministry of Forests and Agriculture before the Governor-General and Commander in Chief of all five provinces of Turkestan. There were minor head offices in the provinces. In the Caucasus the organisation was the same as in the Turkestan.

All Chiefs of Forest districts were serving directly under the Director of the Forest department of the Ministry of Agriculture in Petersburg and submitted their annual reports directly to him, copies being sent to the provincial head offices. Therefore neither the Chief of the provincial office (who needed not to be a forest expert) nor the Revisors (who had to be senior forest officers) were directly over him. Formally they were only inspecting and consulting agencies even if their advice could not be neglecte .

Quite independently, also directly attached to the Department of Forestry were Revisors of Working Plans and Forest Surveys. They had their own staffs of forest experts and surveyors and periodically visited various parts of Russia at regular intervals re-surveying and re-assessing the districts and issuing working plans to be adhered to for many years till the next review of the district. All Chiefs of districts were appointed to the service by the central government and transferred by the Director. The Conductors were often appointed by provincial offices and transferred by them. The forest rangers and guards were usually appointed and dismissed by the Chief of the district whilst nominally in most provinces sanction from the Provincial office or a Revisor was required. The latest development, just before the war, in service organisation, was a scheme providing facilities for keeping successful forest officers for a life-time in the same district without loss to them of opportunites for promotion. It was considered desirable to eliminate the need of transfers to reward successful work and to enable a forest officer to see all the results of a life-time of silviculture in the same district. According to this arrangement there were established three grades of Assistants and Chiefs and two grades of Revisors. The scheme worked in such a way that a successful assistant could gradually, without transfer, rise to the position of a senior grade Chief of district with a salary equal to that of a junior grade Revisor without transfer to a more important post. Since the Chiefs of districts were often living in the forest itself and had the privilege of running a small farm attached to the post, their total earnings often equalled to those of the Chiefs of the provincial head office and in several instances Revisors reverted at their own request to the position of a Chief of district and some even refused promotion to the post of a Chief of the provincial head office. Further, already for some years, Chiefs who had in hand, besides the management of a district, also government commercial utilization work, received a percentage of the profits. This measure was intended to raise the efficiency to the standard of private commercial enterprise, as compared with which government run business was usually slow to compete in the market.

Under this scheme my own total earnings in 1916 were equal to the salary of His Excellency the Military Governor of the Province. (*To be continued.*)

NOTE ON THE NATURAL THINNING IN YOUNG TEAK PLANTATIONS.

In February 1923 some sample plots in pure teak plantations were laid out in the Kaing reserve, Pyinmana division, and in a few cases unthinned control plots were formed for comparsion with those which were thinned.

The plots are situated in ordinary teak bearing bamboo forest of the Pegu Yoma about 400′ above mean sea level. Rainfall averages about 60″ to 70″ and falls almost entirely between May and October. The temperature varies from about 55° to 100°.

The two plots, of which details are given below, were aged 6 and 7 years in 1922 and are now in 1927, 11 and 12 years old. All badly suppressed trees were removed when the plots were formed.

The plantations were formed with a spacing of 6′ by 6′ originally so that there should have been a stock of 1,210 trees to the acre.

Plot 28.—Age 6 years in 1922. Area 0·25 acres. Number of trees in 1922—269 or 1,076 per acre.

The trees were classified in 1922 as follows :—

Dominant 235.
Dominated 26.
Suppressed 8.

The stocking was nearly full and the struggle for existence had only just begun.

At remeasurement in 1927 the trees were classed as follows :—

Of the 235 dominant trees—
96 remained dominant,
48 became dominated,
38 became suppressed,
53 died.

Of the 26 dominated trees—
1 remained dominated,
1 became dominant,

12 became suppressed (of which 3 are dying),
12 died.

Of the 8 suppressed trees—
3 remained suppressed,
2 became dominated,
3 died.

The figures per acre were as follows :—

Year.	All trees.	Dominant.	Dominated.	Suppressed.	Age.
1922 ...	1,076	940	104	32	6
1927 ...	804	388	204	212	11

Deaths—272 per acre.

Plot 25.—Area 0·4 acres. Age 7 years.

In 1922 there were 306 trees or 765 to the acre.

These were classified as :—

Dominant	...	241
Dominated	...	48
Suppressed	...	17

The plot was not very fully stocked as compared with the original spacing but it appeared to be so on the ground.

At remeasurement in 1927 of the 241 dominant trees—
128 remained dominant,
97 became dominated,
38 became suppressed,
36 died.

Of the 48 dominated trees—
8 remained dominated,
23 became suppressed,
17 died.

Of the 17 suppressed trees—
7 remained suppressed of which 4 are dying.
10 died.

The figures per acre are :—

Year.	All trees.	Dominant.	Dominated.	Suppressed	Age.
1922 ...	765	603	120	42	7
1927 ...	607	320	117	170	12

Deaths—152 per acre.

In both cases it will be noticed that, with few exceptions, the original dominated and suppressed trees are either dead or dying and it may be assumed that those which have become so during the five years will follow them.

Most of the deaths seem to have been due to the struggle for existence but a good many may be due to other causes. In any case it happens that the number of deaths is much greater in the more fully stocked area and this may indicate that there was no room for more trees.

The number of dominant trees left amounts to 388 and 320 to the acre at the age of 11 and 12 years, respectively, and, if all the dominated and suppressed trees are likely to die shortly as seems probable, this number seems to be the maximum which the area can support.

Making due allowance for the fact that the stocking is irregular and that some of these trees are standing too close to one another the figures are very near those worked out by Mr. Bourne for the Nilambur teak plantations in Madras.

As compared with the thinned plots the average girth of the dominant trees in the 11-year-old plantation is now 15·3″ against 17·4″, and in the 12-year-old plantation 18·7″ against 20·1″.

G. S. SHIRLEY, I.F.S.,

7th December 1927. *Silviculturist, Burma,*

BRIEF NOTE ON THE BIDDI INDUSTRY IN NORTH CHANDA DIVISION, C.P.

1. *Introductory.*—Before the year 1915-1916 there was no demand in this division for *tendu* (*Diospyros Melanoxylon*) leaves for making biddis.

In that year the right of collecting *tendu* leaves in the Government reserved forests of Wairagarh range were leased out to Pandurang Sao Kalar of Sirsi for Rs. 50, this marks the beginning of the biddi industry.

The reasons why a demand for *tendu* leaves started suddenly in 1915-1916 are obscure, but this may possibly be due to the construction in 1913 of the B. N. Railway small gauge line from Nagpur and Gondia to Nagbhir and Chanda, which brought the forests of North Chanda, particularly those of Wairagarh, Gunjewahi and Brahmapuri ranges, to the notice of the Gondia and Nagpur biddi merchants, or to the great War which made cheap foreign cigarettes difficult to obtain and their price temporarily prohibitive, and thereby induced Indian merchants to commence the manufacture of biddis on a larger scale than before.

From 1915-1916 the demand for *tendu* leaves has increased steadily to 1925-1926 and in 1926-1927 soared upwards. The reason for the keen demand in 1926-1927 appears to be that in that year biddi manufacturers were making a determined effort to keep the Indian market by the mass production of biddis and by underselling the cheap cigarettes with which foreign manufacturers were flooding the Indian market.

The growth in the demand for *tendu* leaves from 1915-1916 to 1926-1927 may well be seen by the accompanying statement A which shows the revenue by ranges from 1915-1916 to 1926-1927 received by leasing the rights of collection.

2. *Method of sale of tendu leaves.*—In 1915-1916 and up to 1922-1923 when the demand for *tendu* leaves was not very great the rights to collect were sold on tender to contractors, but since 1923-1924 in September of each year a public auction of the right to collect *tendu* leaves in the Government reserved forests has been held at Nagbhir. Up till 1926-1927 the rights to collect *tendu*

leaves were sold by ranges, but in that year the rights were auctioned by sub-ranges which resulted in very keen competition.

The successful contractors pay one instalment of the purchase price on signing the contract and the balance in 1, 2, or 3 instalments depending on whether the purchase price is more than Rs. 100 and less than Rs. 250, more than Rs. 250 and less than Rs. 500, or more than Rs. 1,000. Till 1926-1927 the dates for paying the remaining instalments were fixed before the end of March following the auction so that the total purchase price might be recovered and credited in the accounts of the same financial year, but in 1926-1927, as the contractors represented that the actual collection of leaves did not take place till end of April and beginning of May in cases where the purchase price was over Rs. 1,000 1st April was fixed as the date for paying the last instalment.

The reasons for holding the auction so long before collection takes place are, firstly, that successful contractors generally wish to arrange contracts to collect *tendu* leaves in the malguzaris near the Government reserved forest for which they have the contract, secondly, the contractors who are not biddi manufacturers themselves, which is usually the case, generally like to arrange forward sales of the collected leaves to the biddi manufacturers at Diwali in October, and thirdly, the organization for collection and drying of the leaves has to be completed and sites upon which to dry the collected leaves arranged for before collection commences.

3. Method of collection of tendu leaves.—The time of collecting the *tendu* leaves depends on the flush of the new season's leaves. This depends on climatic and local factors and on the age of the plant. In a season of drought the flush is later. Coppice shoots and root suckers produce leaves before old trees. Normally in North Chanda the flush of leaves in the case of coppice shoots and root suckers takes place towards the end of April and in the case of old trees soon after the beginning of May.

The period of collection only lasts about three weeks as the new leaves, especially their veins, soon become too hard and tough.

The leaves most prized are of large size, soft and pliable and of a slightly reddish colour. The leaves of root suckers and coppice shoots fulfil these conditions and on account of this reason and also because the leaves of root suckers and coppice shoots are easier to collect it follows that the leaves from old trees are practically never collected.

The contractor's labour force, usually women and boys, who have been previously engaged for the work by a small advance from the contractor's agents go out into the forest and collect the leaves as soon as they are of sufficient size. The leaves are tied up with thread in bundles of 100 (pudas) by the collectors on getting back to their villages. The collectors are on piece work, the contractor's agents tallying each evening in the village the number of bundles prepared and paying the collectors at the rate of Re. 0-5-0 to Re. 0-10-0 per 100 bundles.

4. *Method of drying the leaves.*—While taking over the bundles of leaves from the collectors the contractor's agent has them laid out in regular order in a clear plot of ground to dry. The plot of ground must be open to the sun and wind and must be fenced to prevent damage from domestic animals. The bundles are turned daily until the leaves are quite dry. The period required for drying is 7—8 days depending on the temperature.

5. *Export and sale of collected leaves by contractors.*—After the bundles of leaves are dried they are brought from the outlying villages to a central place usually where there is a railway station. There the bundles are baled in sacking, 1,000 pudas going to a bale, and are ready for export. The contractor, except where he is a biddi manufacturer or has sold his leaves in advance, does not usually export them but sells them at the station to one of the biddi factory managers or middlemen from Gondia, Tumsar, Bombay, Calcutta, Karachi, Madras who come there for the purpose.

The prices given vary a good deal, depending on the demand for leaves and the quality of leaves. In 1926-1927 when there was a very keen demand for leaves, Rs. 20 to Rs. 30 (upto Rs. 75 for 1st class choice leaves) were paid for 1,000 bundles while at present, when there are large stocks with the contractors

at centres still remaining unsold from the 1927 collections the prices vary from Rs. 7 to Rs. 10.

6. *Local manufacture of biddis.*—A certain number of biddis for local consumption are prepared at Chanda, Bhandak, Sindewahi and Brahmapuri but the industry is not well organised and the biddis are not sufficient to supply the local requirements.

Statement 'B' shows the number of persons employed in preparing biddis at each place, the method of paying the persons employed, their average daily earnings, the daily and yearly consumption of leaves, the daily and yearly outturn of biddis, and the source whence the *tendu* leaves are obtained.

7. *Difficulties hindering development of biddi industry with suggestions to remove same.*

(*a*) Contractors require a plot of land for drying the leaves at each village adjacent to the Government reserved forest from which they are collecting leaves. Many of these villages belong to malguzars who refuse to give the contractors permission or charge very high rents. The reason appears to be that the malguzars collect *tendu* leaves from their own forest.

The difficulty would be obviated if the contractor would take the trouble to arrange to dry the leaves on a plot of land on the boundary line of the Government reserved forest or to take a contract for the malguzari in addition to the contract of the Government reserved forest.

(*b*) Ryots collect *tendu* leaves in their survey numbers, waste and minhai areas of the ryotwari villages (as they have rights to do under rules 9 and 10 framed under Section 204 of the Land Revenue Act) and compete with the contractors of the Forest department. Considering the commercial value of the *tendu* leaves it would seem advisable to class *tendu* leaves with lac, harra, rusa oil and gum and to auction the right to collect from the waste and minhai areas in the ryotwari villages of each sub-range simultaneously with the rights to

collect in Government reserved forest of each sub-range (*vide* para. 5 of revised Appendix X to the C. P. Forest Manual).

(*c*) The manufacture of biddis is an admirable cottage industry and could be developed in this district with a little publicity and organization, firstly because the raw articles required, *tendu* leaves, tobacco and thread are obtainable in quantity on the spot, and secondly, because a large labour supply is available in the hot weather as many villagers find nothing to do at that time.

A. H. STEIN, I.F.S.,
D. F. O., North Chanda Division, C. P.

STATEMENT A.

Statement showing the revenue received from the leases of collecting tendu leaves from the year 1915-1916 to 1926-1927.

Year.		Warora.	Moharli.	Haveli or Chanda.	Brahmapuri.	Gunjewahi.	Wairagarh.	Mul.	Total Revenue.	REMARKS.
1915-1916	...	...	...	...	...	...	50	...	50	
1916-1917	...	...	...	...	50	50	100	...	200	
1917-1918	...	37	...	10	70	...	275	...	392	
1918-1919	...	45	25	...	550	100	1,000	...	1,730	
1919-1920	...	40	50	30	700	135	650	...	1,605	
1920-1921	...	...	...	...	775	725	1,100	...	2,600	
1921-1922	...	...	10	25	475	200	1,000	...	1,710	
1922-1923	...	...	40	80	600	350	815	...	1,885	
1923-1924	...	50	190	100	1,025	800	1,300	...	3,465	
1924-1925	...	100	310	310	1,325	1,900	1,540	...	5,485	
1925-1926	...	100	75	405	1,625	2,100	1,749	560	6,605	
1926-1927	...	130	160	1,725	8,300	10,615	1,395	1,395	26,675	
Total	...	502	860	2,685	15,495	16,985	13,920	1,955	52,402	

STATEMENT B.

Range.	Name of place.	Number of persons employed in preparing biddis at each place.	Method of paying the persons employed.	Average daily earnings of each person per day.	Number of leaves consumed. Daily	Number of leaves consumed. Yearly.	Outturn of biddis. Daily.	Outturn of biddis. Yearly.	Source from which *tendu* leaves are obtained	REMARKS.
Chanda ...	Chanda ...	60	By contract 5 as.–8 as. per 1,000 biddis.	7 as.—12 as.	45,000	16,425,000	90,000*	3,2850,000	Malguzari forest and Hyderabad State.	*2 biddis are made from one leaf.
Moharli ...	Bhandak ...	2	Do. ...	8 as.	1,000	365,000	2,000	730,000	Government contractors.	
Gunjewahi ...	Sindewahi ...	11	Do. ...	11 as.	5,000	1,825,000	10,000	3,650,000	Malguzari forest.	
Brahmapuri	Brahmapuri...	14	By daily labour.	6 as.–9 as.	8,900	3,250,000	17,800	6,500,000	Government contractors and malguzari forests.	

AN EXPERIMENT IN LAC PROPAGATION IN THE BADAMI RANGE, DHARWAR-BIJAPUR DIVISION, BOMBAY.

Natural growth as initiative.

1. Towards the end of 1926, natural growth of lac was noticed on some *basri* (*Ficus Tsiela*), *siras* (*Albizzia Lebbek*) and *ber* (*Zizyphus Jujuba*) trees in the compound of the P. W. D. rest house at Kamatgi twenty miles from Badami. A systematic search resulted in the discovery of occasionally occurring lac in the neighbouring forests. Most of it was phunki lac and live brood was found only on a few trees in Anantpur and Kamatgi forest. It appears that lac has been growing in this tract, especially in the Kamatg rest house compound for many years past, but in the forest it is found on a few species of trees scattered far and wide. The identification of the insect as genuine *Tachardia laca*, Kerr, stimulated interest in undertaking the experiments. Another species of the Coccidae is also noticed in the forest which is found to infest *Acacia concinna* and *Acacia Latronum*. In this the males cannot be distinguished from females. The evacuated thin incrustations are all oval in shape like those of the male *Tachardia lacca*, but much bigger in size than the latter, the colour being pale brown. This species does not seem to produce lac of marketable value as no thick incrustation is found even on a couple of heavily infested shrubs.

Preparatory work

2. Two plots measuring about four acres each were selected provisionally, one in the Kamatgi forest near the rest house and the other in the Anantpur forest near Badami and fenced round. The pruning season had already advanced before these arrangements could be made. Hence, no heavy pollarding of the hosts was resorted to. Some of the *khair* trees were only cleaned by removing dead twigs. The host trees selected are:—

1. *Khair* (*Acacia Catechu*).
2. *Babul* (*Acacia arabica*).
3. *Hodjali* (*Acacia Latronum*).
4. *Wadiya* (*Dichrostachys cinerea*).
5. *Bellad* (*Acacia leucophloea*).
6. *Ber* (*Zizyphus Jujuba*).
7. *Ghontber* or *Godchi* (*Zyzyphus xylopyra*).
8. *Purgi* (*Zizyphus Oenoplia*).

9. *Tugli* (*Albizzia amara*).
10. *Siras* (*Albizzia Lebbek*).
11. *Dividivi* (*Caesalpinia coriaria*).
12. *Hunse* (*Tamarindus indica*).
13. *Jamun* (*Eugenia Jambolana*).
14. *Bili Basri* (*Ficus Tsiela*) or *Basri*.

In the Kamatgi plot the number of trees pollarded in the plot is a little over a hundred, only one of which is *wadiya* the rest being *tugli*. The Anantpur plot also contains a hundred trees pruned and unpruned together. The growth is mixed as detailed below:—

Species.	No.	Species.	No.
Khair	... 56	*Purgi*	... 2
Ber	. 12	*Jamun*	... 1
Tugli	... 8	*Tamarind*	... 1
Ghontber	... 5	*Bellad*	.. 1
Babul	... 5	*Dividivi*	.. 1
Wadiya	... 4	*Hodjali*	... 1
Siras	... 4		
		Total	... 100

Some of the *ber* and *khair* trees in the Anantpur plot were pollarded at the end of April 1927, and fortunately shoot production was opportune and quite satisfactory.

Natural features of locality.

3. The elevation of the Anantpur plot is about 1,740, and that of the Kamatgi plot is about 1,640. The soil in the former is sandy loam, shallow with a substratum of limestone. In the latter it is stony and ferruginous. The climate is dry and warm for the greater part of the year. The average annual rainfall is reported to be 25″, but probably it has scarcely exceeded 18″ during the past 8 years. The temperature usually varies from 70° to 100° F. and some times goes up to 108° for short periods in the summer.

Inocculation.

4. The live lac on the trees in the compound of the Kamatgi rest house was the only source of brood supply. The dates of larval emergence were not known. So, it was necessary to remove a few brood lac sticks at the end of May last to Badami and keep them under observation. The pruned trees in Anantpur plot sprouted and

the shoots were big enough to stand infection by the end of June. Shoot production in the Kamatgi plot was rather slow owing to delayed rains there. The *ber* shoots were most luxuriant of all. On the 24th June last the larvæ swarmed out on one of the lac sticks under observation, which was immediately put on to a host in the plot. A fresh supply of brood was then obtained from Kamatgi and the trees in the Anantpur plot were inoculated. The swarming here actually commenced on the 1st of July. The supply fell short by a small quantity and again a further instalment of brood was obtained. This was rather late, and the result was that heat and vibration in transit caused a sudden emergence of the larvæ and the incrusted twigs being still green and juicy many of the larvæ settled on the open surface of the twigs before, they could be put on to the hosts and were thus lost. Therefore, it is found safer to collect the brood lac at least a week prior to the date of swarming. The inoculation in both the plots was carried on almost simultaneously. The larval swarming continued for well nigh a month that is upto the end of July. The natural growth of lac on the four trees in the two plots was allowed to swarm in situ. The swarming on these trees was more or less simultaneous with that of the *basri* brood on other hosts. *Siras* brood was about a week late. The fertilised tests of the female of the natural growth were but isolated globules and not in a thick mass, which fact probably was due to the damage done by predatory insects. Bundle infection was mostly adopted. Both pruned and unpruned trees and shrubs were inoculated. *Siras* brood was put on to *siras* host, as also a few branches of the same were infected with *basri* brood, as a sufficient quantity of *siras* brood was not available. Similarly, *basri* and *siras* brood were tried on *ber* hosts. But most of the host trees had to be infected with *basri* brood which only was available in sufficient quantity.

5. In order to establish a nursery of brood lac in Badami to facilitate distribution of brood in the vicinity for future operations, as the only local source of brood supply, *viz.*, the Kamatgi rest house compound, was 20 miles away from Badami and also as a safeguard against a sudden failure of crop incidental to developing lac of one species

Brood Lac Nursery.

on a different one, 7 *basri* trees and 5 *siras* trees in the compound of the P. W. D. rest-house at Badami were inoculated with the brood from the respective species. The result is quite promising. In addition, it is proposed to establish a brood lac nursery on an area measuring about 15 acres in Anantpur plantation where the soil is better. The host trees and plants available in the area have already been pollarded for inoculation the next season.

Result.

6. From the time the experimental work was started, frequent observations were made and the result of the development of lac is being recorded in a note book. Brood from young *basri* trees was found more vigorous than that from old trees. The evacuated brood lac sticks were promptly removed off the trees to avoid infection from any predators that may exist in the brood lac. Until 15 days after swarming ceased larval settlement gave hopes of success on all the hosts on which swarming in any degree took place. Thereafter, the young insects on some of the trees slowly faded away and died. The failure on *ghontber*, *jamun*, *tamarind*, *dividivi* and *bella* was conspicuous as not a single insect survived on them. Fortunately, these trees together form a small minority of infected hosts and all these excepting *ghontber*, were from the start looked upon with diffidence. Besides, none of these trees, except *ghontber* were pruned. Out of the total of 209 host trees, 3 *ber*, 2 *siras*, 1 *bellad* and 1 *tugli* in all 7 trees were inoculated with *siras* brood and the rest with the *basri* brood. The result on the 3 *ber* is good. On *siras* the brood has failed partially. And on the 2 *bellad* and *tugli* trees the insects did not survive after 2 weeks. But no definite opinion can be given yet as regards the cause as the inoculation was made on a single tree of each of the two species and also because even *basri* brood has failed on *tugli* in the Anantpur plot, whereas it has succeeded remarkably on most of the *tugli* trees in the Kamatgi plot. The lac growth on *wadiya* is the most healthy of all, and the least damaged by predators. In the case of *ber*, *khair*, *tugli*, *babul*, *hodjali* and *basri*, it is quite encouraging. The number of infected places on a tree varies from 1 to 35 in the Anantpur plot,

1 to 55 in the P. W. D. compound Badami, and 1 to 33 in the Kamatgi plot, according to the number of shoots produced. The result of infection is shown in tabular form below :—

Name of Plot	Number of host other than *basri* infected with		Number of hosts on which infection was successful with		Cost.	REMARKS.
	Siras brood.	*Basri* brood.	*Siras* brood	*Basri* brood.		
1	2	3	4	5	6	7
					Rs. a. p.	
Kamatgi ...	...	100	...	83	15 4 0	
Anantpur ...	7	93	5	70	19 12 0	
Badami ...	5	7	5	7		

7. The result of emergence of the male insects in the beginning of September, *i.e.*, exactly two months after the commencement of the larval swarming was quite satisfactory in that almost all the females were fertilized. The loss in unfertilized females is negligible in both the plots.

Emergence of male insects.

8. Ever since the arvæ emerged they were infected by ants but in spite of the pest the larvæ settled. It is not that the ants are attracted by the larvæ alone as even the uninfected trees are infested by ants, which fact is probably due to the flowering of the *Acacias*. Observation through a magnifying lens discloses that ants which constantly walk over the insects do not do any appreciable damage to them beyond licking up the honey-dew that bubbles out of the incrustations every now and then. But the fact remains that the lac insects that are heavily infested by ants do not get enough scope to develop their filaments. Also it is observed that the association of ants was not harmful to the mature male insects. Yet the presence of ants is not desirable a the lac on trees less

Enemies and predators.

infected by ants is thick and healthy and quite promising with a well developed growth of filaments, looking like sticks wrapped in cotton. In addition to ants and bees which are occasionally attracted by honey-dew, the lac insects had to face a more formidable enemy. About six weeks after the larval swarming, *i.e.*, in the third week of August, young lac insects in Anantpur and Badami plots were attacked by predatory caterpillars. As the lac incrustation was then thin the tunnelling caused by the predators could be easily detected by the dark appearance of the affected parts. Predators being in the larval stage, the only means to combat them was to open up the soft swellings and destroy the larvæ. The removal of the predators is now being carried on daily and thus the damage has been minimised. Still the damage done to the lac is estimated to be about 30 per cent. Up till now nearly a thousand predators in different stages of development have been removed and destroyed from 85 trees. Two kinds of predators have been noticed. The larva of one is one-third of an inch long and that of the other is one-eighth of an inch. The bigger one has been identified at Dehra Dun as *Eublemma amabilis.* The appearance of the predators at a most critical time when the male insects were about to emerge was viewed with alarm. The emergence of the male commenced on the 1st September. Luckily, the consequent fertilization of the female was quite successful in spite of the presence of the predators. It is gratifying to note that the lac on the trees in the Kamatgi plot and in the rest-house compound has remained free from any predators except ants which do not seem to have done any harm.

Possibility of extending lac cultivation.

9 The aim of the experiments is to investigate the probability of lac propagation on a commercial scale. The climate, soil conditions and the nature of the tree growth in the forest in these parts seem to be favourable to lac cultivation. At present, the only brood available locally is from *basri* and as it is not a forest tree and also for the reason that *basri* lac although of good colour is reported to lack weight and has, therefore, low a trade valuation, it is proposed to put the brood on to such forest trees as are common in these parts, *viz.*, *tugli*, *khair*, *babul* and other *Acacias* *ber* and *ghontber*

Photo. by Har Swarup, 1st September, 1927.

Podocarpus neriifolia. Seedlings 6 months old, the 3 to the right having had top of hypocotyl and cotyledons broken off, development continuing from adventitious beds on the hypocotyl.

etc. The result of the experiment is not discouraging in spite of the predators. *Ghontber* is very abundant and as its lac is reported to be of good quality, lac should be tried on this species, by repeated infection or by importing the particular brood. The hot winds in summer and the uncertainty of the rains coupled with the nature of some of the host plants which are vegetatively inactive during the latter part of the summer present some difficulty with regard to successful cultivation of the summer lac crop. Possibly this feature, more than the existence of predators, accounts for the failure of the continual propagation of the lac growing wild in the forest. Should the present experiment succeed it is proposed to select for future operations such areas in which the moisture content of the soil is conserved till late in the summer or in other words such trees as are capable of producing a summer brood, and to establish brood lac farms in different centres of operations to meet any contingency. The November larval swarming is expected in about a week and preparations are being made accordingly.

In conclusion my thanks are due to Mr. Newman, Conservator of Forests, S. C., and to Mr. Kesarkodi, P.F.S., for advice and help in starting this experiment.

BADAMI:
7th November 1927.

S. S. DHARESHWAR,
Range Forest Officer, Badami.

RECUPERATIVE POWERS OF PODOCARPUS SEEDLINGS AFTER INJURY.

In February 1927 whilst in the Cachar division of Assam I collected a few seeds of *Podocarpus neriifolia* which were then ripe and falling. Seven of these seeds were sown in a shallow box on 17th March and all germinated and developed satisfactorily till the middle of June when they were about 4″ high with a terminal whorl of cotyledonary leaves. A piece of wire netting was kept over the box to keep off birds and squirrels, and this was one day accidentally shifted laterally with the result that five of the plants were broken off below the cotyledons, one was

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partially so broken and only one remained unharmed. The five injured plants thus consisted only of the 3" to 4" long leafless hypocotyl and a thick virtually unbranched taproot. A month later, all were still alive and had produced adventitious buds on the hypocotyl as shown in the accompanying composite drawing from a photograph, the buds being near the top when the hypocotyl was erect, but from the highest part where it had drooped over. The photograph was taken on September 9th when the new leaves were nearly as big as the original cotyledons. These mutilated seedlings survived the cold weather and only died in the hot weather of 1927 owing to neglect of watering. The readiness with which most species of *Podocarpus* will grow from cuttings is well known but the production of adventitious buds from the hypocotyl after loss of its upper portion including the cotyledons is unusual as far as I am aware.

H. G. CHAMPION, I.F.S.,
Silviculturist.

EXTRACTS.

CULTIVATION OF FOREIGN SPECIES OF TREES.

BY LAURI ILVESSALO, D. PH., Lecturer in Silviculture at the University of Helsinki in Suomi.

(*Reprinted from Silva Fennica 4 of 1927, by courtsey of the author.*)

The tree flora of Europe is, compared with the flora of other continents on the northern hemisphere, very poor in genera and species. Data given by Professor H. Mayr * concerning the number of genera and species of trees in the cool and temperate zones in Europe, North America and Asia are, in this respect, illuminating, even if they are not absolutely correct. In these zones there are in Europe only 7 genera and 18 species of coniferous trees, whereas the corresponding figures for the eastern part of North America are 13 and 30, for the western part of North America 22 and 50, and for eastern Asia 26 and 100. Of deciduous trees, there are in Europe 30 genera and 60 species, in the eastern part of North America 100 and 220, in the western part of North America 34 and 70, and in eastern Asia 150 genera and 400 species. Very marked is the scarcity of genera and species in the

* HEINRICH MAYR: Waldbau auf naturgesetzlicher Grundlage, Berlin 1909, pp. 49—50.

northern parts of Europe. *E.g.*, Suomi has only 4 genera and the same number of species of coniferous trees and 12 genera and 18 species of deciduous trees, out of which number 2 species of coniferous trees and 3—4 of deciduous trees are of economic value. The tree flora of Scandinavia is almost as poor: only the deciduous trees are represented by a few additional species.

Investigation of the history of vegetation gives evidence that the tree flora of Europe has not always been so poor in genera and species as at present. During the tertiary period stately forests abounded which in richness of genera and species were quite comparable with the present forests of North America. *Sequoia, Taxodium, Chamæcyparis, Thuya, Magnolia, Liquidambar, 'Liriodendron* and other coniferous and broadleaf trees which are not in the present time natives of the European flora, but are so in North America, were distributed over large areas, till the catastrophe of the glacial period almost totally destroyed this rich tree flora north of the Pyrenees, the Alps and the Carpathians. The traces of this destruction have only partly been restored by the great migration of tree species which took place in the post-glacial period: the destroyed forests were replaced with new ones, but these were far poorer in genera and species than the forests of the tertiary period.

What nature has failed to do in the work of reconstruction, man has tried to supplement, *i.e.*, measures have been taken to enrich the naturally poor tree flora by acquiring new species from other continents. The earliest efforts in this direction were made in Central Europe in the 17th and in Suomi in the 18th century, but systematic experiments with the cultivation of foreign species were begun only as late as towards the end of last century. Even these experiments were, however, mostly rather summary and therefore frequently unsuccessful. More positive results were obtained only after the experiments in the cultivation of foreign trees advanced from the summary stage on a solid scientific basis. The chief merit for this is due to Prof. Mayr who in his works and articles emphasized the plant geographical attitude.

The cultivation of foreign species of trees is, however, not a purely European question. In South Africa and Australia which

have a comparatively poor native flora of coniferous trees, experimental cultivation of South European and North American conifers has been taken up. In the mountains of New Zealand, among other trees *Larix europæa* is cultivated. On the slopes of the Himalayas and in Java South American Cinchona trees are cultivated. In Java, extensive plantations of the rubber trees (*Hevea brasiliensis*, etc.) have been made, likewise in the Malay Peninsula. In California, experiments are being made with Australian Eucalyptus trees and in the eastern states of the United States and in south-eastern Canada with European species. The cultivation of trees beyond their natural area of distribution, from having been a European, has thus become an international silvicultural question with far-reaching economic consequences.

It seems, therefore, necessary to examine on what general premises the cultivation of trees outside their natural area of distribution is possible. Questions of chief interest are then: the choice of species, the origin of the seed used, the choice of site and the method of formation and tending of a culture.*

In the choice of species we are bound within limits due to the climate of the area of cultivation. Each species will thrive only in a climate which fulfils its claims of heat and moisture. Each species has its optimum climate in which it flourishes best and the more climatic conditions differ from this optimum, the more difficult it is for the tree to thrive, until this becomes impossible. Experimental cultures made in Europe with species that are natives of different climates in different parts of the world† show that the degree of success of each species is proportionate to the degree of similarity between the climate of cultivation and the climate of natural distribution. The more the climates in question differ from one another, the poorer have

* See A. K. CAJANDER: Metsanhoidon perusteet. II Suomen dendrologian paapiirteet. (Principles of Silviculture II. The main features of Finnish Dendrology). Porvoo 1917.

Id.: Der Anbau ausländischer Holzarten als forstliches und pflanzengeographisches Problem. (Acta Forestalia Fennica 24, 1923.)

† See LAURI ILVESSALO: Ulkomaalaisten puulajien viljelemismahdollisuudet Suomen oloja silmälläpitäen. (On the possibilities of cultivation of foreign species of trees, with special regard to Suomi.) (Acta Forestalia Fennica 17, 1920.)

been the results. The same conclusions have been reached from experiments with species of the northern hemisphere, made in the southern hemisphere (Australia, New Zealand, South Africa).* It is, therefore, necessary as Mayr has already emphasized, for experimental cultivation to use in the first instance mainly such species as are natives of a country with a climate similar to that in which experiments are made. The possibilities of cultivating certain species of trees are, however, far greater than could be judged only by the climate of their native country, as has been clearly shown by experiments. So, for instance, *Chamaecyparis Lawsoniana* and especially *Picea omorica* and *Pinus peuce* seem to thrive in Europe in such regions in which the climate differs considerably from the climate of their very limited area of natural distribution, a fact which can probably be explained by other, biologically stronger species having limited their natural area of distribution. Thus, their area of distribution is far smaller than would have been the case, if climatic conditions had been the only active agents. Such comparatively rare exceptions to the general rule, however, show that, even if we have, in the choice of species for experimental purposes in the first place to be guided by climatological reasons, we must not in a summary way leave out of our experiments all species which do not come from a country with marked similarities in climate to the country where cultivation takes place. This is all the more necessary, as in many cases available data concerning the climate of the country of origin are incomplete.†

Origin.—Clearly as Mayr has expressed the idea that foreign

* See ERNEST H. WILSON: Northern trees in Southern Lands. Journ. of the Arnold Arboretum, 1923, pp. 61—90.

† As guidance in the search of climatically corresponding regions, the divisions of climates of Köppen, Köppen-Passarge, De Martonne, and others, may be used. In Suomi, Cajander's division which is closely related to that of Köppen, has been accepted. His division has been developed with due consideration to plant geographical and silvicultural views, and to the maritime or continental nature of a climate which is of such importance in the case of cultivating foreign trees. (A. K. Cajander: Zur Frage der gegenseitigen Beziehungen zwischen Klima, Boden und Vegetation. Acta Forestalia Fennica 21, 1921.) The plant geographical zones put forward by Mayr (Picetum, Fagetum, etc.) include too heterogeneous climatic regions to serve as sufficient foundation for comparing climates.

trees must come from climatically similar countries, he took quite a negative attitude to the question of origin in the narrower sense. However, in cases where the area of distribution of a species includes climatically different sections, the results of experimental cultures vary according to the section, where the seed is obtained. The species in question are apparently divided into biological races, a fact which has already been previously observed in the common pine *(Pinus silvestris)* and in the common spruce *(Picea excelsa)*. In Suomi especially A. F. Tigerstedt, who has carried out experimental cultivation on his estate Mustila (lat. N. 60° 44′, long. 26° 29′ E.) on a grand scale, has drawn attention to the problem of origin and established its great importance for many species.* So, for instance, young plants of Douglas fire *(Pseudotsuga Douglasii* Carr.) from seed obtained from the West Coast of the United States (Oregon) could not endure the climate of South Suomi, whereas seed from Quesne gave rise to plants *(Pseudotsuga Douglasii*, var. *caesia* v. Schwerin) which thrive extremely well and were at the age of 13 years 4—5 metres high. The climate of Quesnel is about the same as in Mustila, whereas the climate in the west is far more maritime. In Central Europe, both the main coastal form as well as the variety *caesia* have succeeded, but the former has proved to be a faster grower because it comes from a climate which is more like that of Central Europe, especially in its more maritime parts. Young plants of *Pinus Murrayana* Balf. raised from seed which was obtained from Montana, did not grow in Mustila nearly as well as plants from seed which came from the region of Banff (Alberta), the latter growing faster. Round Banff climatic conditions are very similar to those of Central Suomi. *Picea sitkaënsis* Carr. from Alaskan seed has thriven tolerably well, but from Oregonian seed no plants could be got. Therefore, if for experimental planting ordinary seed to be had in the market is used, as is still mostly the case, we are on unsafe ground and cannot from our failures draw the conclusion that a certain species is not suitable for cultivation. Full certainty concerning the adaptability of a foreign tree can be attained, only

* A. F. Tigerstedt: Arboretum Mustila. (Acta Forestalia Fennica 24, 1922.)

when seed from regions with a corresponding climate has been used in the experimental planting. Therefore, it is essential that seeds are delivered by reliable persons in the native country of the tree, *e.g.*, with local foresters as intermediaries. In cases where there are already in the country itself fairly well thriving and seed making stands of foreign trees, such seed ought to be utilized for planting new stands, as under such circumstances we can be convinced that it is of suitable origin.

The choice of site.—The climate of even highly uniform regions shows local variations, which are due to variations in the formation of the surface It is, therefore, not only necessary that the climate of a region, where the planting takes place, corresponds on an average to the climate of the country whence the species (the seed) is derived, but the very site of the plantation must show this correspondence. The conditions of the soil must also be taken into account. The importance of the correct choice of the site is shown especially by the experimental plantations of Tigerstedt. When Tigerstedt began his experiments in the early part of this century, he had not yet found time to acquire sufficient experience concerning the site which different species claim, and the result was that several species were planted on unsuitable sites and did not thrive well. But these difficulties were gradually overcome by the study of literature, through correspondence and travels abroad, and thus it was possible to place each species under experiment on a site which corresponded in the highest possible degree to the biological claims of the plant. Many species which on the basis of previous experiments had been regarded as unfit for cultivation, were now found to be quite satisfactory. Even new results have been obtained : through the choice of most favourable sites even such trees have been a success as in their native regions have a somewhat more favourable climate than Mustila. Species that claim a higher mean temperature have been planted on warm southern slopes with rich soil, and species that are used to a warmer winter and a more even climate, on slopes with rich soil, but not on southern slopes as they always show greater variations in temperature than northern and eastern. Again, when a species comes from regions

where the yearly rainfall is greater than in Mustila, the scarcity of rain has been compensated for by planting them on humid or even moist soil. These methods have often given excellent results.

Information concerning the soil foreign species claim is often very vague or even contradictory in the dendrological literature, and it is, therefore, not an easy task to take into account the claims of a species in this respect. It is true that the conditions of soil are intimately connected with those of the climate, especially of temperature and moisture, so that a climate has its corresponding conditions of soil, or, in other words, that climatic areas have roughly corresponding areas of soil. But, in spite of this, local conditions of soil vary considerably. Investigations prove that the so-called forest types* fairly well reflect the conditions of soil.† If it were known on what forest types foreign species appear in their native country and how they grow in different types of forests, it would be far easier to choose a correct site than at present. When the region of planting has the same types of forests as the country of origin of a species, the forest type can simply be used as a guide; or else the species should be planted on a type of forest which corresponds biologically to those types on which it thrives well in its native region. So far, forest types are sufficiently investigated only in a few countries.

The method of formation and tending of culture, as experi-

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* A. K. CAJANDER: Ueber Waldtypen. (Acta Forestalia Fennica 1, 1909.)

A. K. CAJANDER: und Yrjö Ilvessalo: Ueber Waldtypen II. (Acta Forestalia Fennica 20, 1921.)

A. K. CAJANDER: Was wird mit den Waldtypen bezweckt? (Acta Forestalia Fennica 25, 1923.)

A. K. CAJANDER: The Theory of Forest Types. (Acta Forestalia Fennica 29, 1926.)

† J. VALMARI: Beiträge zur chemischen Bodenanalyse (Acta Forestalia Fennica 20, 1921.)

YRJÖ ILVESSALO: Ein Beitrag zur Frage der Korrelation zwischen den Eigenschaften des Bodens und dem Zuwachs des Waldbestandes. (Acta Forestalia Fennica 25, 1923.)

V. T. AALTONEN: Ueber de Aziditätsgrad (Ph) des Waldbodens. (Communic ex Inst. Quaest. Forest. Finlandiae edit. 9, 1925.)

ence shows, exercises considerable influence on the result. Previously, foreign species were planted (or sown) in most cases in Suomi (as well as in Central Europe) mixed with either native species or with one another. The results were, however, anything but satisfactory; in mixed stands of indigenous and foreign species the latter were suppressed almost without exception and often totally destroyed, and when two foreign species were planted mixed, the species that grew quickly in its early age usually gained, while the other suffered. Therefore, the formation of mixed stands soon had to be abandoned and they had to give place to pure stands. The influence of the method of formation and tending on the results of experimental cultures is clearly exemplified by the experiments of TIGERSTEDT. In Mustila, foreign species have generally been planted in fairly large groups or small stands. Species sensitive to frost have been planted in small gaps of the old growth pine forest or, in the case of shade tolerant species, under thinned forest. The method last mentioned has also been applied to such conifers as are sensitive to the warmth of the sun in the early spring. Thus, planted in the cover of the woods, in Mustila even such maritime species have thriven well as would have been destroyed, if planted in the open. As the trees have grown bigger, the covering forest has been thinned in order to ensure them sufficient space, till it has ultimately been cut down altogether. For the young plants of tender species special measures are, of course, necessary, too, in the nurseries (*e.g.*, spreading of bast mats above the young plants during frosty nights). It is also suitable to found a nursery under the cover of a thin forest, on a slope declining gently towards north or east. A sufficient number of young plants must be grown, so that the nursery yields enough healthy, vigorous plants, and weak ones may be discarded.

Successful cultivation of tree species outside their natural area of distribution involves:—

that in their area of distribution a climate similar or nearly similar to that of the region of cultivation is to be found;

that seed is procured from that part or those parts of the area of distribution, where the climate is most similar to the climate of the cultivation;

that a site which satisfies the biological claims of the species is chosen for the cultivation, and

that the method of formation and tending of the culture satisfies the biological claims of the species in a sufficient degree.

In order that foreign species should not only be capable of cultivation, but also *worth* cultivating, they must, if they are not meant to fulfil only ornamental purposes, offer real advantages over the native species. Among such may be mentioned :*—

(1) The wood of a foreign species differs to such an extent from that of the indigenous species that it is suitable for a purpose or even several purposes better than the indigenous.

(2) Greater production of wood.

(3) Smaller pretensions concerning the site (afforestation of drift sand ground and heath land).

(4) Greater endurance against spring frosts and cold in the winter.

(5) The foreign species yield valuable by-products (as rubber quinine, tanning material, camphor, sugar, etheral oils, nuts).

As additional advantages the following may be considered :—

(6) A foreign species resists damage from cattle or game (*e.g.*, *Picea pungens* and *Picea sitkaënsis)*, insects, fungi, etc. (*Pinus peuce*) better.

(7) A foreign species improves the soil (*e. g.*, *Robinia pseudo acacia*).

Many of the advantages mentioned above are such that long and systematic planting experiments, often in conjunction with experiments with indigenous trees, are necessary in order to establish them with certainty. The fact that in many countries experiments with several species have yielded economically important results shows that sacrifices for the experiments are justified. In Suomi, two species of larch (*Larix sibirica* and *L. europaea*) have been naturalised, which both yield more produce than the indigenous species and in addition to this are more suitable for such special purposes for which durability against

* See A K. CAJANDER : Metsänhoidon perusteet. II. Suomen dendrologian pääpiirteet. (Principles of Silviculture. II. The main features of Finnish Dendrology.) Porvoo 1917.

Larch planted by Mr. Trevor at Nagni in 1916.

rotting is necessary.* European larch has also been thoroughly naturalised in the Scottish mountains. In Central Europe, Douglas fir and White Pine *(Pinus strobus)* have proved to be excellent forest trees, likewise Sitka spruce *(Picea sitkaensis)*. In Hungary, Robinia (*Robinia pseudoacacia)* has attained unexpected economic importance. (The area of Robinia forests there is calculated at about 100,000 hectares). In countries on the Mediterranean and in South Africa, California, etc., Eucalyptus trees have been planted with success. The Monterey pine (*Pinus insignis Dougl.* syn. *P. radiata* Don) has become a favoured forest tree in Australia. We have already mentioned the Cinchona plantations in India and Java, and the rubber tree plantations in Java and in the Malay Peninsula. In many other regions of the tropical zone rubber trees have proved to be as productive as in their native country far outside their natural area of distribution. These are only mentioned as examples. Many useful species of trees which have a comparatively limited natural distribution, have thus already become international property, although systematic experiments based on a firm scientific foundation have generally only just been started.

[We illustrate *Larix europæa* 11 years old at 8,000 ft. at Nagni in the Kulu division, Punjab, (Plate 18), and would be glad to send seed to any forest officer who may be sufficiently interested to write to us.—Ed.]

EGYPT AND MALARIA.

In December last, the great irrigation engineer, Sir William Willcocks, delivered a lecture, entitled "Why is Cultivated Egypt Immune from Malaria?" at Cairo, and any new information on such a subject must obviously be of interest to malaria-stricken India. If there is a country which by reason of its climatic and

* *An excellent* example of how well the Siberian larch thrives in Suomi and at the same time of the fact to what results' cultivation of a foreign species may lead under favourable circumstances, is the famous Raivola larch forest in south-eastern Suomi. (See Lauri Ilvessalo: Raivolan lehtikuusimetsä. (The Larch Forest of Raivola, Commun. ex, Inst. Quest. Forest. Finlandiae edit. 5, 1923)

other conditions should be eaten up by malaria, it might well be thought that it would be Egypt. Yet the cultivated Nile valley from Aswan to the Mediterranean is immune. There are places on the edge of the cultivation like Ismailia and the Khanka desert farm where malaria occurs, but they are not cultivated Egypt. It was shortly after the construction of the sweet water canal to Ismailia that marshes formed in the depressions north-east of the town, and Ismailia was decimated by malaria. It was after some years of irrigation at the Khanka farm that clear seepage water showed itself in the low-lying land, and there was a severe outbreak of malaria. There is nothing in the climate or physical conditions of Egypt to keep the scourge in check, it can be as bad in Egypt as anywhere else where the conditions are favourable to mosquito life, but there is no malaria in cultivated Egypt. Sir William Willcocks says that during all the long years he slept in a tent or in the open between rice fields, surrounded by marshes, and travelled about the delta on foot or in a boat, he never had a touch of fever. It was not that he was himself immune, he went to Greece to report on the reclamations of Lake Copais and in spite of every form of screened protection he suffered badly, he suffered in other places, but not in Egypt. Neither he nor the men who accompanied him on his tours contracted the disease, nor did they ever see anyone with it.

In these circumstances, Sir William had for years tried to solve the problem of the immunity of Egypt from malaria with no success. But a comparatively few months ago, Dr. Bateman of the Old Cairo Hospital, read him some extracts from Dr. d'Herelle's work "Immunity in natural infectious diseases," in which he gave reasons for the immunity of certain districts in the Argentine and reclaimed areas in Holland from malaria; and Dr. Bateman added: "It is our clover which protects us." He then went to Mr. Gray, director of the chemical laboratory of the Ministry of Agriculture, and consulted him. Mr. Gray replied that on the face of it, it was clover. With this clue, Sir William carried his studies further. Egypt has, in a wild or cultivated form a wealth of clover and leguminous plants. All over the irrigated areas, ideal breeding grounds for mosquitoes throughout

the year, where there are swamps, stagnant pools, sluggish drains there are also the clover fields "like sentinels over the health of the perennially irrigated delta," and in addition to the clover there are extensive areas of legumens, beans, lentils, lupins, fenugreek, chickpeas (Indian gram) and ordinary peas, with a strong contingent of wild clovers, vetches and peas. Countries, neighbours of Egypt, have poor leguminous crops and have been plagued with malaria from time immemorial. Alexander the Great died of malaria trying to reclaim the marshes of Babylonia; during the war our men suffered in Palestine, Salonika and elsewhere; but apparently from the earliest antiquity Egypt has been protected by its wealth of leguminous crops, especially of clover. There is every opportunity for the malaria mosquito to propagate malaria, and there is no malaria. In Dr. d'Herelle's book it is said that the greater part of the Argentine is completely free of malaria though mosquitoes abound, and in all the free regions there is a wild, scented clover, on the juice of which containing coumarin, malaria mosquitoes feed; and the author suggests that coumarin may play a rôle in the insects comparable to that which quinine plays in man. The mosquitoes which cause malaria in man are carriers of malaria, to give malaria they must have malaria to carry, and if they are themselves free from malaria their bites cannot induce the disease. There would therefore appear to be something in the leguminous plants, particularly in certain kinds of clover, which makes mosquitoes immune.

If that is the case in Egypt, there would seem to be no reason why appropriate action should not be taken elsewhere. The conditions of different countries vary, but there is a very wide range of clovers and legumens, and it should be possible by experiment to select *suitable* leguminous plants for the purpose in view. Incidentally, clover has other values, it is not cultivated in Egypt ostensibly to stamp out malaria, it is a valuable fodder crop for cattle, and in Egypt and Uganda it is alternated with an exhaustive crop like cotton in order to maintain the yield. Sir William Willcocks concluded his lecture with the words: "It would pay any malaria-ridden country to write to Washington and get information from people who have first-hand informa-

tion and are ready to give it; to buy the hardy sweet clover from local seedsmen in the Western States and begin operations in suitable gardens and nurseries; to send specialists to collect the seeds of the 'trebol de olor' and local clovers in the *Argentine; to get* the wild clovers which grow under lupins and in the open in Northern Europe and Southern Egypt; to get the seeds of the fodder crops of Egypt; and to get the coumarin beans and seeds from Guiana and Brazil, and plant them. . . . Malaria is such a terrible curse and its suppression over the face of any country by changing malignant malaria mosquitoes into benign ones would be such a blessing that no one responsible for regions where malarial fevers are the common *heritage of the people* should find it possible to contemplate cultivated Egypt's immunity from malaria and shrug his shoulders and do nothing." It is only very briefly that Sir William Willcocks' presentation of his case has been given here, the whole paper merits the attention of authorities in India, and it is hoped that the notice of medical officers and agricultural experts will be drawn to it.—["*Indian Engineering*," *28th January 1928*.]

FORESTRY IN THE EMPIRE.

A meeting of the Royal Colonial Institute was held at the Hotel Victoria last evening, when Lord Clinton, Chairman of the Forestry Commissioners, read a paper on "Imperial Forestry." LORD LOVAT, Parliamentary Under-Secretary to the Dominions Office, presided.

LORD CLINTON *said that* the whole subject of forestry was of the first importance to the Empire. It was a matter of somewhat recent recognition that forests, as they had been managed in the past, were a rapidly wasting asset. With the ever-increasing quantities of timber used for industrial and other purposes and with the vast annual losses due to fire and insect and fungoid pests, the lifetime of the primeval forests of the world was growing dangerously short. Wasteful methods of lumbering still *prevailed and the steps hitherto taken to prevent* this and to provide for the regeneration of the forests were still inadequate,

It was estimated that the quantity of timber used and destroyed amounted to eight times the annual growth. Efforts were being made in all parts of the Empire to deal with the problem. Every Dominion and Colony had a forestry service of its own, and with the good will of the different Governments much might be accomplished.

A recent census taken of all the woodlands in the kingdom showed that War feelings and heavy taxation had seriously reduced the supply of timber, and that the break-up of estates had prevented its replacement. As a result of the forest service which had been created in this country, a satisfactory amount of work had been done in the education of forest officers in universities, in the training of foresters at woodmen's schools, and in silvicultural and scientific research into the many problems which affected forestry work. Nurseries had been established which contained over 200,000,000 seedlings and transplants sufficient for the next three or four years' planting. At close of the planting season it was estimated that 114,000 acres would have been planted. Between 3,000 and 4,000 woodmen were employed and over 500 small holdings had been established for the workers. The main hope for forestry here and throughout the Empire was that public opinion should be educated, and should keep successive Governments alive to the importance of a continuous policy and of making provision for the future.—[*The Times.*]

EMPIRE TIMBER EXHIBITION.

An exhibition indicating the possible utilization of Oversea Empire timbers in industry will be held at the Exhibition Pavilion of the Imperial Institute from February 3rd to April 30th. This exhibition is the second of a series arranged to direct attention to specific resources of the Empire, with the object of increasing the usage of Empire raw materials in this country. Samples of selected timbers from some of the Dominions and Colonies will be shown, in conjunction with the articles which can be made from them. The exhibition will be of special interest, among others, to architects, builders, cabinet makers, motor-body

builders, pianoforte manufacturers, railway engineers, and carriage builders.

An important feature of the exhibition will consist of exhibits illustrating the work carried out at the Imperial Forestry Institute, University of Oxford; the Forest Products Research Laboratory (Department of Scientific and Industrial Research) at Princes Risborough; and at the Imperial Institute.—[*The Times.*]

TREES FOR POSTERITY.

An account was given in these columns recently of the work of the Forestry Commission in providing for the needs of the future. More trees, it was stated, are being planted in this country than anywhere else in Europe. So far as it goes, this sign of practical progress, even if the improvement is only relative is very welcome. It means that the Commissioners are making good use of the limited means placed at their disposal. When the next generation begin to ask what their fathers did after the Great War the answer, so far as the country's timber supply is concerned, will not be altogether discreditable. But the advance made is only a beginning. It is still true that, whereas on the Continent one-third of the total land area is under timber, the proportion in Great Britain is only about four per cent. and that this island, which draws something like nine-tenths of its timber supply from abroad (at an annual cost of £100,000,000) has less forest land per head of its population than any Continental country. On the other hand it is stated on excellent authority that there are in Great Britain something like five million acres of waste land, on a large part of which, thanks to our comparatively moist climate, it would be possible, though the soil is not suitable for agricultural cultivation, to raise new forests.

The total forest area in the Dominions and Colonies is estimated at 1,837,000 square miles, one-third of which has been rendered available for marketing purposes, and yet in spite of these vast resources, only one-fifth of the timber annually imported into this country is Empire grown. At the same time, the still more disquieting fact has to be faced that the world at large, in

the provision and use of the principal timbers of commerce, is living not on its annual increments but on its capital. At the present rate of consumption the existing supplies of soft wood in Canada and the United States are not expected to last for more than another twenty-five years. When they are exhausted the plight of Western Europe will be serious in the extreme, since any substantial relief from other parts of the globe will be practically out of the question. In view of this uncomfortable prospect, the eventual aim of the Forestry Commissioners is to establish in this country one and three-quarter million acres of State forests, 150,000 acres of which will, it is hoped, be planted by the end of 1929. In spite, therefore, of the excellence of the work which the Commissioners are doing, it is evident that its progress, in relation to the immensity of the task, is exceedingly slow, and that until much more money is devoted to its development the deficiency, instead of being overtaken, will steadily continue to increase. At the present moment it is not to be expected that the Government will be able to find the large additional amount of financial assistance which would be required during the next twenty or thirty years if the prospect of a timber famine is to be averted. No doubt in course of time the drive of necessity will compel the invention of practical substitutes for the soft woods of commerce in at least some of their uses. But so far as the real article is concerned, it is of the utmost importance that the country at large should realize that neither in Great Britain, nor in the Empire, nor in any other part of the world are the present generation taking steps adequately to provide for the needs of posterity.—[*The Times.*]

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THE MATCH INDUSTRY IN INDIA.

Greater interest is being evinced in the match industry in India now that the Tariff Board is carrying out an enquiry to decide whether this industry is to receive support by the imposition of a protective tariff.

Match factories have been in existence in India for many years but, for the most part, they merely struggled for existence while many were started and failed altogether, mainly owing to the severe competition of matches imported from Japan. This state of affairs existed till 1922 when an import duty of Re. 1-8-0 per gross of boxes was imposed on the import of matches into India. This duty was imposed as a revenue producing measure but, fostered by this duty, the existing factories began to flourish and many new factories have come into being.

The growth of the industry in India from that date is very evident from a study of the figures of import. In the year 1922 13,680,801 gross of boxes of matches were imported while in 1925-26 the imports dropped to 7,937,522 gross of boxes, or nearly half that of 1921-22. This decrease indicates that the demand is now being met by the products of Indian factories and the present state of affairs (so it is understood), is that 25 per cent. of the consumption is met by Indian factories, 25 per cent. by the Indian factories of the Swedish Match Company, and 50 per cent. by imports, chiefly from Sweden.

Past experience has shown that the match industry cannot flourish without some form of protection but, given this protection

it will be interesting to consider the prospects of this industry in the future.

Research into the suitability of Indian timbers for match making was first instituted by Professor Troup, at the time that he was Forest Economist, and he arranged to have many species which appeared likely to be suitable for this industry, tested by Roller & Co., of Berlin, well known makers of match making machinery. Many of the timbers which were pronounced to be suitable have proved to be unsuitable from manufacturing experience so that no reliance can now be placed in the reports in his " Memoirs."

Certain Indian timbers such as *papita* (*Sterculia campanulata*), *mau-lettan-she* (*Sarcocephalus cordatus*), *geor* (*Excœcaria Agallocha*), *semul* (*Bombax malabaricum*), *didu* (*Bambax insigne*), etc., have been declared to be suitable for the manufacture of matches but the splints obtained from these species do not compare in quality with those made from aspen, the species commonly used in Europe. A timber to be suitable for match splints must be white, straight grained, strong enough not to break while the match is being struck, must absorb paraffin readily and must burn without the emission of smoke or smell. Up to the present no timber has been discovered in India which has all the attributes required for a first class match but it has been proved by manufacturing experience that India does possess timbers which will make serviceable matches, though not of such good quality as those made from aspen.

There are, however, two great difficulties in obtaining supplies of Indian timbers. The first is that timbers suitable for match making are mainly derived from mixed deciduous forest in which they occur intermixed with other miscellaneous species and not in pure forest as is the case with aspen. This greatly increases the cost of extraction and often makes the price that must be paid for the timber excessive. Secondly, most of these species are found in inland forests where communications are, in many instances, non-existent and this, coupled with the fact that the only eventual lead to the factory is often by railway, greatly increases the cost of the timber. In fact, in most of the factories situated near large seaports it is found more economical to make

use of imported aspen rather than Indian timbers. It has been the contention of many forest officers that it does not pay to sell softwoods for match making owing to the low price obtained and manufacturers have complained of the difficulty in obtaining supplies. This state of affairs is largely due to the difficulties of extraction which have been referred to above.

If India is to make use of indigenous timbers for the manufacture of her matches, it is apparent that the solution of the question of supplies lies in the formation of plantations of species which from present experience are considered to be suitable for the industry and which are known to be of fast growth.

A reference has been made to the work done by Professor Troup, when Forest Economist, and since that date the Forest Economist's Branch of the Forest Research Institute has collected and recorded the opinions of the various manufacturers on the species which have been used and tested by them and has also arranged for supplies of timbers to be sent to various firms for test. In addition, timbers have been tested by the West of India Match Company and an experimental factory has been set up by the Government of Bihar and Orissa The Swedish Match Company has kindly loaned a veneer cutting machine and a splint chopping machine to the Forest Economist and this is now being installed with the intention of carrying out further research into the suitability of different species for match splints.

From the reports received from manufacturers it is apparent that there is a great divergence of opinion as to the suitability of any one species for use in this industry. This can be accounted for by the fact that the manufacturer is bound to compare the suitability of the species being tested with the species which he ordinarily makes use of in his factory, and a manufacturer who habitually makes use of, say, *semul* is more likely to report well on a timber than one who habitually uses imported aspen. Again, some factories make use of machinery throughout for the manufacture of matches while others carry out part of the operations by hand. The latter may, therefore, fail to discover the unsuitability of some species for use in one of the machines which has not been installed.

If the Tariff Board finally decided that the match industry s to receive protection, it is obvious that further research will be necessary before the best use can be made of Indian timbers. Such research will have to be carried out by a match making expert with a complete match making unit at his disposal so that he will be able to study the behaviour of a timber throughout the process of manufacture and at the same time this expert will have to be a qualified engineer, competent to effect changes in the design of standard match making machinery to suit Indian timbers.

It is only by independent research of this kind that the industry can expect to receive the greatest aid and such research could only be carried out under the auspices of the Government of India.

ELEPHANT KHEDDAHS IN BURMA.

BY THITTAW-WUN.

Noon and a sun-drenched jungle, the silence broken only by the buzzing of innumerable insects and the occasional raucous scream of a hornbill, with now and again the sharp crack of a breaking bamboo to betray the presence of the herd. Although it was still the cold weather the deep shade of the *danen* brake was very welcome to the animals, some forty in all, who were just passing the time away until the cool of evening and the call of hunger would draw them to their feeding grounds in the big patches of *kaing* grass along the river banks. No elephant is ever really still—a still elephant is a sick elephant—and even those that were dozing gently against the occasional big trees were still lazily flapping their ears and swinging their trunks and tails. Others were kicking up earth to fling over their backs or blow along their bellies, and some, the more energetic, were wandering slowly about sampling the bamboos growing at the edge of the cane-brake. A peaceful scene, but destined to be short lived.

Along one of the ridges from which a game path dropped into the cane-brake was winding a file of thickset wild looking little men, clad in the baggy blue cotton pants and V-necked

shirts of the Karen, and all armed with the inevitable dah, the Burmese sword, either carried along the flat of the forearm, the blade projecting beyond the elbow, or tucked into the back of the pants with the blade sticking out to one side. Each man carried a gaily embroidered bag slung from the shoulder stuffed to bursting point with food for several days, his betel box and a number of Chinese crackers. Silently they surrounded the unconscious elephants, and little did the great beasts realize that these would be the last moments of peace and freedom they would know for many weary months.

I had that morning marched over to Thebyu, the Place of the White Sand, to inspect the operations and had hoped to time my arrival for the first drive of the season. That preparations were complete was obvious from the barricades of dry bamboo we passed, each provided with several little tin vessels of kerosene stuck on the ends of bamboo stakes.

These were put up as "stops" to the game paths leading out of the kheddah area and were all in readiness for firing when required by the men driving the herd. Elephants were in the neighbourhood all right, for we had already run into half-a-dozen animals, which had caused some excitement and restlessness amongst my baggage animals, two of whom were themselves recent captures. However, the splendid din my scallawags kicked up by beating the empty kerosene tins, bath tubs, etc., hung on behind effectually scared the wild ones away.

When in due course we arrived at Thebyu I took my little elephant Nellie and rode down to look at the stockade, which had been constructed in heavy evergreen jungle about three-quarters of a mile from the bungalow. There we met the party of hunters just leaving their camp, and though I told them of the animals we had met that morning, they were going in the opposite direction in search of the main herd, news of which had just been brought in by a scout. On my asking whether they expected to round up the animals that day the *lugyi* (the headman replied that he could not say, but that as the herd had been definitely located he expected they would certainly make a catch within the next day or so. So telling him to send word

to the bungalow as soon as they had conducted the animals within reasonable distance I went on to the stockade.

The Karen kheddah is worked on a different principle to the Indian kheddah, which I understand is usually a circular stockade of fairly large dimensions, from which the wild elephants have to be forcibly removed with the aid of *koonkis*, as the tame elephants trained to this work are called. The Karens, on the other hand, do not normally use *koonkis*, or at any rate not to anything like the same extent, and the stockade therefore requires to be constructed on different lines. The Karen stockade consists of a long narrow passage, long, that is in relation to its breadth, blocked at one end, and with a funnel like opening at the other, the funnel being formed by two long diverging wings. In fact to imagine the plan of an ordinary funnel gives one a very good idea of a Karen kheddah except that in it the passage is made short in proportion to the wings. At first sight the whole affair seems too small and flimsy for words, and the thought of endeavouring to keep twenty or thirty large and angry animals safely inside it makes one feel that at that joyous time one would hurriedly remember a prior engagement elsewhere! I had this particular kheddah measured, and the following are its dimensions:—length from gate to end 100′ breadth at gate 12′, at end 7′, height of walls 10′ and distance between wings at the mouth of the funnel 850′. The whole thing is constructed entirely of material collected on the spot, or at any rate in the forest. The main posts, which give to the structure such strength as it has, are young trees of about 2′ 6″ to 3′ girth and 16′ in height, firmly imbedded in the ground at 9′ intervals. They are strengthened by fairly heavy struts notched in on the outside at a height of 6′ from the ground; and each pair of opposite posts is tied together at the top by a thick twisted rope of bark fibre. The ends of the struts are kept in place by stakes driven well into the ground. To these main uprights are bound three pairs of horizontals at 3′ intervals, the top-most pair being thus 9′ from the ground. One of each pair is notched in on the inside of the upright and the other on the outside. The spaces between the uprights are then filled in with

poles of about the thickness of a man's forearm, which are slipped down in the narrow space between the horizontals and driven firmly into the ground. Intervals of 3 or 4 inches are left between these poles, so that the men can easily get their arms in, incidently this also allows the elephants to get their trunks out, an unpleasant little habit which renders strict attention to the business in hand advisable.

The gate is a wonderful contraption on the portcullis principle. The gate posts are double, that is, two on each side, with a space of a few inches between in which the gate runs. They are rather more substantial than the other main posts of the stockade, and considerably higher, and between them at the top a flimsy little platform is rigged up, reached by a bamboo ladder. The gate itself is constructed on the same principle as the walls of the stockade, except that spaces are not required between the poles. It is put together, and inserted between the two pairs of gate posts and then by a long rope running over a pulley bar underneath the eyrie referred to above it is pulled up to leave a clear passage into the stockade, the other end of the rope being made fast to some handy tree near by. The lower ends of all the poles forming the gate are sharpened. The idea is of course obvious. One gentleman sits on the little platform on top ready with a dah, and as soon as the last elephant is in, or he thinks as many are in as the stockade will hold he cuts the rope and the gate crashes down by its own weight, the pointed stakes entering the ground and keeping it fairly firm.

The whole of the space enclosed by the wings is cleverly camouflaged by large fronds of the *danon* stuck in the ground, effectually preventing the elephants from seeing where they are going, but offering no obstruction.

That evening after tea, X, his wife and I were out for a stroll in one of the neighbouring teak plantations. We were naturally on the *qui vive* for sounds of a drive, and suddenly became aware of unusual vague noises some distance away on the other side of the kheddah. These gradually came nearer and nearer and we were soon able to distinguish raucous shouts and

sharp explosions Realising that a drive was on, and coming in the right direction, we decided that the immediate neighbourhood was likely before very long to be no place for a woman, so hurried Mrs. X back to the bungalow, about a quarter of an hour's walk, and then ran down to the stockade. The noise of the drive was now rapidly approaching, and we could hear, mingled with the yells of the hunters and the explosion of their Chinese crackers, the crashing of the elephants as they burst through the undergrowth. We then fairly doubled along, but unfortunately just as we tore down the hill on to the kheddah we heard the thud of the falling gate, and as we arrived pandemonium broke loose. It was by this time practically dark, and a wonderful sight met our eyes. The stockade was surrounded by naked savages all carrying long bamboo torches, yelling and screaming and bounding into the air with excitement—did I mention that these people are paid by results—and within the stockade seemed to be full of mad elephants, rushing up and down, trumpeting and bellowing, and trying to break through. But this is where the restricted space makes itself felt—if the stockade enclosed a large space, in which the animals could move freely, they would walk through it as though it were made of paper, but as it is they can move only along its length—at the blind end it is so narrow that it is strong, and the only real danger spot is the gate. This was bulging horribly as we arrived on the scene, two large cows having rushed at it simultaneously, and with their fore-feet up were pushing as only elephants can push. However just as the gate began to look like a Burman baby's tummy, someone distracted the ladies' attention with pokes in the ribs and streams of abuse, and we managed to slip several thick poles into the slideway of the gate, myself meanwhile with one eye on a large tree conveniently near.

All this time the elephants were careering wildly up and down inside, and how the two babies that were included in the catch (thirteen animals in all we discovered later when it became possible to count them) escaped being trampled and kicked to death I cannot imagine. The animals could not, of course, be left like this charging about inside, or they would soon

have damaged one another hopelessly, or probably managed to break out during the night; so at once, the gate being firmly secured, steps were taken to put an end to their mad rushes. Each man stuck his blazing torch into the ground and seized a coil of thinnish rope, lying heaped up with slip-nooses ready. He pushed the end through one of the gaps in the palisade, and with a long hooked stick opened out the noose to about 18" diameter. This was arranged flat on the ground about a foot or two inside the stockade, just in the path of one line of charging animals. In a moment or two an elephant put his hind foot into the noose, which was immediately jerked tight, and the free end run two or three times round the nearest main post of the stockade. The elephant was of course pulled up, or stopped to see what had got him by the leg, and as he shifted about the slack was quickly taken up until one foot was bound firmly against the stockade. Then fishing for the other hind foot commenced, and when this was caught in a similar manner—not so easy, as the animal, unless a fool, soon realised what was going on, and kicked about or shifted his foot immediately he had put it down—he was tightly strapped up by the stern and free only to swing round through a semi-circle. As each hind foot was caught and dragged up to the side the slip noose was secured by a length of thin cord so that it should not work loose and allow him to kick his leg free. In this preliminary fishing no attention was paid to an elephant putting his fore-foot into the noose, as it would be hopeless to get him to the side by a fore-leg—he would have the noose off with his trunk long before he could be secured.

This angling for elephants was going on simultaneously all round the kheddah, but each party was spaced out at least an elephant's length away from the next, so that their respective captures would not interfere with one another. It was not long before the majority were trussed up by their hind legs, but the last few took some time, because of course, as they continued to charge up and down the stockade, they were being constantly deflected from a straight path by their already captured relations and as these obstacles were continually moving, it became a

matter of considerable difficulty to judge where the loose one would put his foot. Besides, the tethered animals were always spotting either the noose or the stick with which it was arranged, and dancing on them with squeals of rage or jerking them out of the men's hands to smash them into little bits. However, at last it was done and the stockade looked like a river full of unwieldy barges, rocking violently at anchor under the influence of innumerable powerful cross currents! I had a cast or two at the most exciting fishing I have ever done, but having missed two or three strikes realized that I was losing a lot of fun by undue concentration, so handed the line over to the original owners, and returned to a more general interest in the performance.

As soon as all the animals, big and small, had been thus tethered, one of the most interesting parts of the whole show took place. The stockade was rapidly roofed in with numbers of thin poles, which had of course been cut and piled in readiness beforehand. A dozen or so of the Karens swarmed up the outside of the stockade, and arranged the poles, passed up from below by the other men, transversely across the top, inserting them about a foot apart in the spaces between the wall poles, on the top of the uppermost pair of horizontals. On top of these and also about a foot apart were laid a few more poles running lengthways. None of these poles were tied down or secured in any way, and as most of them were not by any means straight, the general steadiness of the platform can be imagined. They were then joined by their pals from below, armed with their forked sticks and long coils of enormously thick rope nearly as thick as one's wrist. From this ricketty platform and just above the heads of the elephants there then commenced a new and much more exciting form of "fishing." In order not to miss anything I also climbed up and took up a position on the roof, but after a very short while found that, not being accompanied by a pal with a stick to jab at investigating trunks, the continual lepping round from one foot to the other, on thin poles that always turned over when you stood on them, was much too nerve-racking, and moreover occupied one's attention to the exclusion of everything else. So I moved up one storey, and perched on one of the twisted

cables holding the main uprights together. This was a great vantage point, and one could change from one cable to another as the scene of greatest activity shifted. The only snag was that this superior position gave one the full benefit of the smells and the flies, both, those of a dozen very unclean stables rolled into one. I realized then that Hercules' effort was no parlour game. However, neither smells nor flies were sufficient to put one off, and were ignored in the general excitement. Below, the sport left mahseer-fishing cold! After all, even the most accomplished angler has never so far presumed on the credulity of his audience as to claim having hooked a 2½ tonner! That was the idea of the platform. So far the animals had been anchored only at the stern—they had to be anchored for'rd too. The scheme was to squat above an elephant's head-end, carefully lower a noose of the rope over his forehead, and *try* to slip it round his neck. Easy enough, you'd say, but you forget his trunk, which is an extremely efficient arm, without the drawback of an elbow-joint. Of course some of the animals were fools, or were either too frightened or too tired to notice the rope until the loop had touched the ground and been edged gently backwards and then jerked up round their necks, and then it was usually too late as the slip-knot was on top at the back of their necks, and was rapidly secured in place by a bit of cord, to prevent its either coming loose, or throttling the animal. Others, however, were far too wily to be caught like this, and one animal, a *haing* (the name the Burmans give to a tuskless bull-elephant) put up a great fight for at least half an hour. The first shot or so missed, and then he realized what was happening, and, waiting each time until the noose was dangling against his forehead, threw up his trunk and in a flash flicked it off. Once he got hold of the rope and as quick as lightning dragged it down "hand over hand" nearly taking the operator with it. Then he had a great time for a minute or so—squealing with rage he danced on the rope, and flung it about the floor, and then, getting hold of it a few feet from one end belaboured his companions, himself, and the stockade until he was tired of the amusement. He got hold of several of the forked sticks too, the men being too slow in pulling them away. Those gave him no trouble, he just put a foot on one end

and broke them up into little pieces with his trunk. When not occupied with these diversions he was doing his best to drag the operators from their platform, to treat them as he had treated their sticks. However, a trunk is a very delicate organ and he did not like having it poked with pointed sticks. It must be noted here that the Karens are extraordinarily careful not to injure the animals more than can be helped, and I never saw a man, for all his excitement, jab at an eye, or really hard at any part of the animal's anatomy—at least, I suppose one jabbed hard enough—but the sticks are not sharpened, and do no damage in any case, as the tenderest parts of the body, such as the ear hole, or behind the ear, are usually chosen for attention, much force is not required to make the animal take notice. The men's favourite retort appears to be to spit at the elephants, or perhaps it is considered to have a soothing and calming effect, whatever the reason may be, expectoration, or rather the sound accompanying that habit, is continuous on all sides.

To return to the *haing*—having chewed up several more sticks, and made himself generally obnoxious he at last succeeded in "hooking" himself. He had got hold of another noose and was swinging it about trying to decide what to do with it, when he swung it under his own neck, and with a sudden snatch the man above jerked it up, and his little side show was over.

The thick rope having been successfully looped round the animal's neck the free end is passed out through the side of the stockade and the animal edged round by tickling his off ear-hole etc., the slack of the rope being taken up as he moves, until he is standing close alongside the wall of the stockade. The neck rope is then secured round a handy tree, or one of the main uprights, and he is moored fore and aft.

In the meantime the ropes on the hind-legs have been changed for substantial cables; and as soon as he is firmly secured by the neck, similar cables are put on his forelegs. This also is no child's play, as he can kick most efficiently and there is not much left of a man's hand that has been trodden on by an elephant. While his attention is occupied by one or two men teasing him in various ways another squats on the ground up against the wall

and as much out of the line of vision as possible, and inserts the end of a rope into the stockade behind his legs and endeavours to hook it round his off leg with a stick, or with his hand if the animal is still,—or sometimes they endeavour to get him to put his foot in a noose, making him lift it by banging his toe-nails. Whichever way it is done a noose is eventually round his off leg. It is then swathed round both legs in a figure of eight and pulled tight. That being accomplished, it is easy enough to put a big cable on each foreleg, fastening the ends to the wall or to trees.

At last all the animals are trussed up like this, except the babies; they are merely tied up by one hind leg, or perhaps both, and an awful hullaballoo they make about it too. The babies always seem to be more vociferous than the bigger animals, and it is really very funny to see the poor little beasts straining away at the rope, pulling so hard that they are nearly on their heads, with their hindlegs well off the ground, and all the time with their mouths wide open emitting the most ear splitting shrieks and bellows. It is extraordinary the noise a little animal three or four feet high can make. They have to be tied up for their own sakes, as they will not remain with their mothers, but rush up and down in between the legs of the bigger animals. The little ones in consequence get the most appalling kicks, and on several occasions we had to intervene to prevent them being badly savaged by a big one. I suppose the truth of the matter is that the poor beasts are so unnerved and excited that they vent their spite on everything within reach, even on one another. I have seen a big animal deliberately try to kill a *butcha* that ran between his legs by squashing him against the wall, and another seize the baby's neck in his mouth and worry it like a dog.

It is very necessary to get the animals tied up as soon as possible, for not only do they damage themselves by charging against the walls, but they damage one another, and a big tusker may kill several of his herd before he can be secured. It is said that they have on occasions to be shot inside the stockade in the interests of the other animals, but it is more than likely that a very great deal of damage would have to be done before a native

kheddah owner would be prepared to forego the big price he hoped to obtain for a grown tusker. In any case the owner is not usually present when a capture takes place and the Karen operators, besides probably not being armed to deal with a full grown elephant, are paid by results and would always hope to save the lot. As a matter of fact, efforts are usually made to exclude a big tusker from the catch by cutting him out in the drive, with part of the herd, if necessary. He is always a nuisance and it is highly improbable that he would survive the ignominy of capture. The mortality among full grown animals, particularly bulls, both at and after capture, is high, and personally I am of opinion that all fully mature animals, over about 25 or 30, should be released as soon as possible. They are too old to stand the indignity and loss of freedom, and like the oak, they cannot bend, but only break. On another occasion not at the kheddah I am describing, I witnessed a most deplorable illustration of this. A full grown *haing*, a beautiful animal in the very prime of life, enormously powerful and just the build of a dragging elephant, suddenly fell down dead, while standing trussed up in the stockade awaiting his turn for removal. He was not being worried or hunted about, in fact there was nobody near him, we were all examining another elephant that had also just died when a shout from the stockade brought us all running up to find him hanging on his ropes. These were cut at once but he was already dead. The other animal, also a *haing*, had just been extracted and put into his small cage without any very great difficulty—he didn't fight much—when suddenly in the midst of his struggles he was still. For a moment or two the deathly stillness was not noticed, the men being engaged in securing the ropes, but the crucial test of shoving one's thumb into his eye had just shown that he was gone, when the shout from the stockade brought us to the other animal. Neither of these poor beasts was in any way damaged, and they must just have died of broken hearts. This was about 12 or 14 hours after the actual capture. In the case of the present kheddah there was one tusker, a big animal, but not very old and with small tusks, with which fortunately he did not do very much

damage. He did, however, give one small cow a bad dig on the spine, and she eventually succumbed. He died, externally undamaged, about a month later.

To return to my story, however. As soon as all the animals had been safely trussed up, fodder—bamboo leaves, wild plantains, etc.—was thrown in in front of each animal, and troughs dug for water just outside the stockade walls which the animals could reach with their trunks. It being then midnight and the show being over till the morning, I returned to the bungalow and dinner.

The next morning I had to return to Kyachaung—Tiger Stream, a most appropriate name too—whence I had come, to get on with my job. So having had *chota hazri*, I despatched the elephants with my kit, and went down to the kheddah to see the rest of the business. All round the main stockade, built up against any convenient large tree, were a number of small pens, the individual cages. These are constructed in the form of a narrow triangle, the apex being the tree. They are about 12 feet long, the base of the triangle, the gate, being about 4 or 5 feet wide, the whole thing just big enough to contain a large elephant. They are very flimsy affairs, three sets of horizontal poles, and two sets of uprights, the second pair forming the gate. A slightly raised flooring is constructed of bamboos. Four short poles lie alongside in readiness. There are about 25 of these pens constructed about the place, as many, in fact, as the kheddah will hold elephants. The animals are removed in turn from the main stockade, and confined in these small pens until they are sufficiently tractable to be taken out and kept tied up to trees. The removal of the animals from the main stockade and their insertion into the pens is, perhaps, the most thrilling part of the whole business.

As we arrived preparations were going on for the first removal. A large and irate cow had been chosen, and a hole was being made in the wall of the stockade just in front of her head. It will be remembered that all the animals had been left the night before with a long cable round each leg and one round the neck. These were now all doubled in the case of the cow to

be removed, in fact I am not sure that she was not provided with *three* round the neck. The far ends of those round the forepart of the body and half of those at the stern were then loosened in turn and taken out through the hole in the wall, and with two or three men to each the ends are given a couple of turns round convenient trees. These various cables were spread out fan-like in front of the hole, in the direction in which she was required to go, the two cables of each limb opposing one another, so that there would be a pull in every direction. The remaining cables were then slacked off very gradually and the front ones pulled, the slack being taken up round the trees as the animal moved. She did not like it at all at first, but was gradually edged forward by jabs in the tenderest part of her stern, and once a foot was moved there was no going back. The cables from her hindlegs still holding her in the stockade were loosened, and out she came with a rush, to be pulled up with a jerk as the other ropes took the strain. She was a fine sight then, standing there straining against the ropes in a fury of rage, and blazing defiance at the world, her extended trunk drumming on the ground, or furiously flinging over her body the earth she was kicking up with her feet. Then a man would advance yelling to threaten her with a spear, and she would lunge forward at him, or swipe at him with her trunk. The usually accepted statement that an elephant's trunk is always curved up out of the way in action, and not used for offence or defence, appears to be fiction. Thus little by little she was urged forward towards the *kyon-kyat* (the small pens, pronounced "choan-jut"). To accelerate matters, and to help in the final insertion into the *kyon-kyat*, the two *koonkis*, Ma Hla U (Miss Beautiful Head) and Ma Nge (Miss Little) were brought up, and as necessary exerted judicious pressure from the rear. But with the lady in question there was very little work for the *koonkis*; she was full of fight, and wanted no encouragement from behind to charge forward whenever her ropes let her. It seems curious, but appears to be the fact, that it is the females and particularly the younger ones, that carry the fight up to the last minute. With the bulls, after their first rage has expended itself, it seems rather a case of passive resistance. The bull referred to above who collapsed and died of a broken heart just

as he was being secured in his pen, showed none of the fight of this cow. Soon after he was dragged out of the stockade an uneven pull on his cables brought him over, and making little effort to get up again he just lay there until the *koonkis* forced him to rise. There was no active furious resistance with him, he just hung a dead weight on the ropes, and Ma Hla U got very annoyed with him.

The men are extraordinarily clever at manœuvring these enormous beasts about, and it is no easy matter to get them into a *kyon-kyat* which does not happen to open in the direction they are working from. This is where the *koonkis* are really useful. When the animal's head approaches the entrance to the *kyon-kyat*, the *koonkis oung* him round (" oung " meaning to push logs, etc., about with the head) until he is facing the entrance, the cables being hurriedly changed to suit the new direction, and everyone heaves on the front ropes, or shouts and jabs him behind, to try and run him in. This is, however, where things are usually held up a bit. He recognises the structure in front of him as meaning confinement again and has no intention of going in willingly. What usually happens is that he jams his shoulder or his head up against one of the gate posts and then nothing on earth is going to get him in without a complete destruction of the cage itself. So Ma Hla U comes up while Ma Nge stands ready behind. Then a great shoving match ensues. They grip mouth to mouth with trunks twisted round one another, and while the mahout bobs up and down on her neck, kicking her behind the ears, Ma Hla U pushes and heaves and grunts, until the odds in the shape of ropes being all against him the wild animal eventually gives way to jam himself against the other gate-post!

Sooner or later, however, Ma Nge times it well, and just as the wild one gives way to Ma Hla U, he receives an enormous heave from behind and with a despairing bellow in he crashes. Then both *koonkis oung* him well home and the gate poles are slipped in, one behind his knees and another higher up behind the root of the tail, and he is a prisoner again. Another pole is quickly run in under his belly so that he cannot lie down and

then he is rapidly swathed across the back with ropes, and fastened so firmly into the structure that if he did succeed in breaking away from his tree, the cage would go with him. This has to be done quickly, because except for the rope round his neck fastening him to the tree, he is virtually unfettered as soon as he enters the *kyon-kyat*, the leg cables obviously being of no further service. And good use he makes of his temporary freedom—one moment on his head with his hindlegs on the gate-poles—the next on his hindlegs with his forelegs straining against the tree or the horizontals of his cage, the whole of which rocks and sways alarmingly. However, it is not a moment before the all-important back ropes are run across, and small ropes lashing his feet to the sides of the cage take the place of the big cable, and he is as securely bound as he can be. Then, his future attendant and trainer left squatting by his head, singing to him or otherwise endeavouring to calm him down, the process is repeated with all the other animals until the stockade is empty.

The removal of the *butchas* is most amusing, there is none of this *tamasha* with them, of course. The end of the rope is handed to Ma Hla U, who takes it in her mouth and walks calmly away, and out comes the *butcha* squealing and bellowing and dashing about wildly on the end of the rope until two or three men fall on him and push him off towards his tree, where he is tied up and left to bleat ignominiously—none of the dignity of a *kyon-kyat* for him. If he is very small and his mother is in the catch he is let loose as soon as she is in her cage. I remember seeing one poor little beggar about the size of a St. Bernard lying on his side absolutely flat on the ground, with ridiculous little trunk and tail extended, alongside his mother's cage. I thought he was dead, he lay so still amidst all the noise and excitement, but he was only sound asleep, thoroughly exhausted and worn out. He was quite recovered the next day and soon became the camp pet. Another *butcha* was very funny to watch. His mother had apparently not been caught, or any way relationships had not by then been determined and he was tied up alone. He was a most vociferous youngster, and in the intervals of standing on his head at the end of his rope yelling blue murder, he stood with his legs

wide apart rapidly flapping his absurd flabby little trunk up and down against his forehead and chest alternately just as though it were a bit of soft leather. He looked the most ridiculous object with his little pig eyes squinting defiance, and the furiously flapping "mere-smear" nose. Kipling's delightful "Just So" story has more truth in it than might at first be imagined. A baby elephant's trunk is not a trunk but only a nose, though perhaps "mere-smear" hardly does it justice. It is an absurd shrivelled up little article only a few inches long, and quite useless for anything except breathing until the baby is six months old or more.

The elephants remain in their *kyon-kyat* for some days, with their attendants continually beside them, talking and singing to them, climbing on their backs and massaging them, and swabbing them with a mixture of sweet oil and the pounded astringent barks of various trees, *bambwe* (*Careya arborea*), *thitka* (*Pentace burmanica*), etc.

In a few days the animals become reconciled to the proximity of human beings and are then taken out of their cages and kept firmly tied up to trees. They are still very wild, of course, and have to be very securely roped, and fettered with figure-of-eight cane on both pairs of legs. Otherwise, as occasionally happens, they would break away and all the trouble and expense would go for nothing. It is during this period that they usually develop the dreadful rope galls from the continual tugging and straining, the old healed scars of which are almost invariably visible round the knee joints of kheddah animals. The anointing with oil and bark mixture referred to above is to prevent when possible, or failing that to cure, these sores and to keep flies out of them. The continual application gives the animals an extraordinary blue black glistening appearance, with reddish patches where the powdered bark alone has been dusted over raw places.

After a month or so of this very real bondage relieved by the gradual removal of the more irksome ropes, the animals are tame enough to be led or ridden about for their own water or baths, and to be kept tethered by a single long chain out in the jungle where they can feed themselves,

As the months pass their training goes on until, at the end of five or six months, when they appear before a selection committee of forest officers who exercise Government's right of pre-emption, they are as a rule quite tame and in good condition again, and know and respond to the commoner words of command, though training for such specialized professions as timber-dragging continues for another year or 18 months. An animal is not usually fit for real work of any sort for a good two years after capture.

Such is the general system under which elephant kheddahs are conducted in Burma. The system is by no means universally approved, and it has been suggested that the more frequent use of *koonkis*, and the release of mature animals, particularly bulls, would tend to bring about a reduction in the mortality, which is at present higher than one could wish. Many people consider, also, that Government would be justified in demanding a considerably higher royalty on each animal captured than the present Rs. 50, at the same time paying the full market price for any animal taken over, which should be the best of the catch for the purposes required, and not the third best, as under some existing agreements.

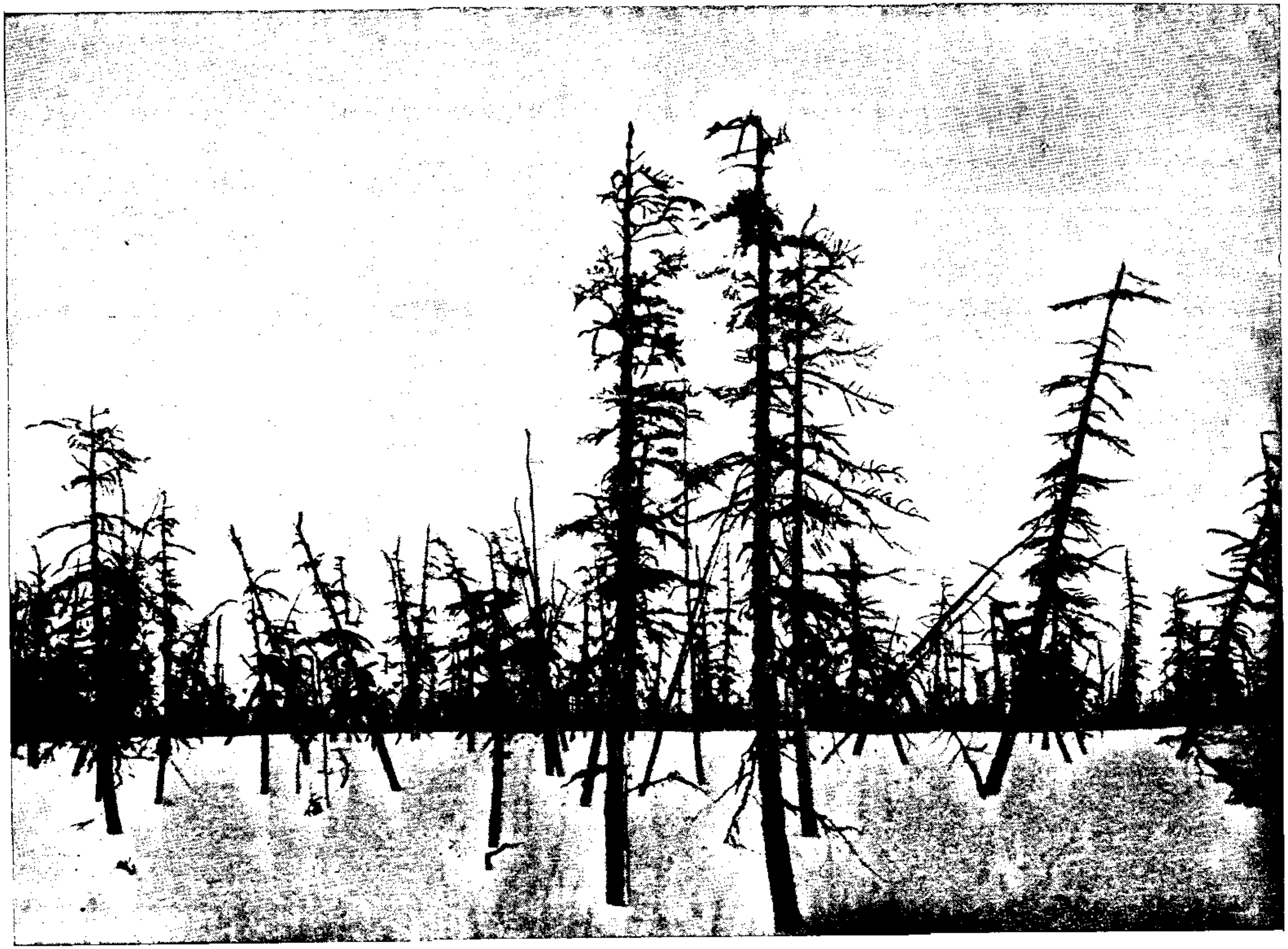
The whole subject of kheddah operations has, however, recently been under investigation by the Government of Burma, as being connected with the more general question of game preservation as a whole, and it is likely that before long several necessary changes will be made in the rules regulating these matters.

SOME ASPECTS OF FORESTRY IN RUSSIA.

By V. Pelts.

(Continued from 215—225 pp. of the April number.)

To describe adequately the distribution of forests in Russia, the climatic factors, the transport facilities, and to some extent the geography have to be considered.



Larix dahurica at the limit of tree growth in the Siberian Arctic.

European Russia, and Northern Asia (known as Siberia) are one continual lowland and any differences found are only gradual as one progresses from the Baltic Sea to the Pacific Ocean. There is no dividing line as shown on maps and most of the Ural mountains are for practical purposes non-existent and represent only some preconceived ideas of a border between Europe and Asia, not existing in reality. If one travels from Petersburg to Tashkent in Central Asia one is supposed to cross the southern end of the Urals and to cut through part of Western Siberia, but all that happens is that soon after passing the Volga, forests disappear and the first mountains met are the Mugojars, a steep small range not shown on ordinary maps and far beyond the Ural. The same railway line branches also to the Far East, so that one can pass on to the Pacific without having seen anything of the Ural, which is in most parts merely a height of land dividing the river systems which drain east and west. The Urals are a better geographical term for an area abounding in forests and rivers, and containing rich deposits of iron ore, one famous hill consisting of practically pure iron. On a straight line from the Carpathian mountains in Poland to the Pacific no mountains are seen except in some parts of the Urals. In the other direction from the Arctic to the south the whole country is also one continuous plain with only one elevation at Waldai exceeding a thousand feet. The first real mountains met, are those in the Crimea, far to the south, then eastwards the Caucasian ranges, then the mountains in Central Asia and the endless line of high ranges along the southern border of Siberia reaching to the shores of the far Pacific. Accordingly there is neither in European Russia nor in Siberia (excluding the southern mountain ranges) any rigid natural limit for vegetation and the distribution of natural forests is merely the result of climatic conditions. Dry figures of maxima, minima, and average temperatures of rainfall and moisture by themselves give no complete picture even to people well versed in the valuation of climatic factors. I will try to give a better idea, by describing the distribution of a few guide plants, only occasionally mentioning meteorological data.

The northern limit of the distribution of the oak (*Quercus*) marks the botanical limit for the " middle line " of the forest one.

The European oak grows in Sweden up to the Arctic circle. It is met in south Finland (on the Baltic Sea), but is rare near Petersburg, this being its northernmost limit. The line then steeply descends south eastwards to the northern shore of the Caspian Sea. Neither in north-east European Russia, nor in Siberia can the European oak grow as the winter minimum temperature is too low. It should be remembered that although the Caspian Sea is on the latitude of Paris the summer maximum temperature on its eastern shore reaches 113° Fahr. not differing much from the maxima in India and the Sahara, while, near the same north-eastern shore a winter minimum of minus 29° Fahr. is met, a temperature unknown in most parts of Arctic Sweden. It is also surprising that in Petersburg, (due of course to the moderating influence of the Baltic) the minimum is rarely below minus 13° Fahr., whilst at Moscow, (directly south but far from the sea minus 22° Fahr.) is encountered and this minimum continues south-east ward till the Caspian is reached.

The northern limit of coniferous forests in the north-west is on the border of Sweden and Finland near the Arctic Ocean. Further east the limit descends south and in Central Siberia permanently frozen ground is found at the latitude of London. Here is the so-called climatic Pole—the coldest place on earth with temperatures much below the minima ever observed on the North Pole or anywhere else in the Arctic Ocean. There several mammoths (*Elephas primigenius*) have been recovered frozen since prehistoric times, the only animals of former geological ages ever discovered with meat and skin complete ; so much so that on two occasions the carcass was readily eaten by dogs and wolves. Obviously there are here no forests and the ground melts only deep enough to permit the growth of herbaceous plants and mosses.

Shortly it may be said that on the northern shores of the Caspian sea the summer temperatures known in the Sahara and the Indian desert meet with Arctic winter unknown even in the north of Sweden or the maritime provinces of Canada.

Asia joined with Europe being the largest mass of land on earth produces in its central part in the neighbourhood of the

Caspian a climate exhibiting the highest summer maxima and nearly the lowest winter minima to be found anywhere, and to make the case more surprising, on the southern shore of the same Caspian (in Gilyan) oranges are the only trees grown in gardens. Having given the medium line of the forest zone as shown by the northern limit of oak and the northern limit of forests caused by permanently frozen ground in north-east Siberia, we will discuss the southern limits of the forest zone.

The southern limit is not determined in any way by temperature conditions but by a different factor, moisture. The question has often been debated if forests ever covered the so-called black soil of southern Russia. It appears that this soil is a product of herbaceous vegetation dominated by grasses of the genus *Stipa*. Folklore describes a beautiful picture of steppes covered by *Stipa*, of the endless expanse of a sea of silvery waves when moved by the wind, a sight now rare in southern Russia but known within historic times. The *Stipa* is now becoming rare, the reason being ascribed to the lowering of the ground water level due to the decrease of forests in Central Russia with the consequent drying up and erosion of the rivers. There are forests in South Russia but they are the product of afforestation during the beginning of the past century. It has been found that the country is now too dry to give new forests any chance to hold their own unless they are for many years carefully protected and tended until the ground becomes covered, and something like forest-soil is created. Terracing and afforestation of ravines has been started by a special branch of the Forest Department.

The steppes of Southern Russia continue into Western Siberia till the Altai mountains and a similar configuration is again met on the borders of Manchuria.

Other forests of a different kind commence in the far south beyond the steppes in the foothills of the Caucasian range which stretches from the Black Sea to the Caspian. Behind that range in Trans-Caucasia things are different and forests abound not only in the hills but also in the lowlands at least in the humid western part towards Batum where a dense vegetation occurs

of a tropical type with exotic palms and lianes. In the eastern part towards the Caspian the lowlands are dry without forest further east, beyond the Caspian no forests for more than a thousand miles both south and east are found till the Pamir, the Tian Shan and Altai ranges are reached. The *saksaul* forests of the deserts of Turkestan have been already described in this journal. The mountain forests in Northern Caucasia start in the foothills, in Western Trans-Caucasia they descend to the lowland, while in Central Asia there is no forest below four to five thousand feet, except the *saksauls* of the desert.

Russia being a country of immense size the forests must be distinctly divided according to the purpose for which they are used. In small sized countries with small distances the same forest might be exploited for several purposes, for instance export and local use of timber. This is rarely the case in Russia since forests serving for export are usually of a vast size where the local requirements for timber are negligible.

In the past railways were not of much importance so far as timber export was concerned. The railway net in European Russia is much denser than is commonly believed, but even here the distances are too great. From Petersburg to the Black Sea is nearly 2,000 miles by rail; from the Baltic to the Pacific something like 6,000 miles; river transport was, therefore, of greater importance than railways. However most of the railways having been built by the State make the shortest cut between points and can, therefore, work at extremely low rates. Timber prices having risen in the world markets it is likely that in future when things settle down timber will come by rail to the sea ports and navigable rivers. Transport rates have been very low even in the past; the usual rate was about 2 shillings per ton per 100 miles for firewood, at which rate, with higher prices for timber, export might be quite possible even up to a thousand miles by rail with present rates of timber in London £14 to £38 per standard (equal to £3 to £8 per ton).

People used to railway rates in India will be surprised that transport can be effected at such low rates when higher wages

have to be paid to the subordinate railway staff. The areas of timber exploitation were previously as follows :—

1. *The Baltic export.*—By rail from different parts of Finland to the coast. By rail to the ports in Finland, Latvia (Riga and Libau) and Esthonia and partly by river from Poland to the Baltic. This area exported besides firewood, high grade big logs, sawn boards and railway sleepers. In this area extensive forest only occur in Finland and Poland. In Latvia and Esthonia the forests are well managed but are not large.

2. *The Arctic export.*—(White sea port Arkhangel). This was the most important export area, capable of much expansion and with no local consumption. The main factor in running this export was the floating of coniferous timber by the northern Dwina river to the sea. This area is capable of immense development since the river system and the railway command 400,000 sq. miles of forest.

3. *Central and South Russia.*—Practically no timber exists in excess of home requirements. Some was exported, but mainly selected valuable timber worth transport by rail.

4. *The Urals.*—To understand the condition of this area we must consider the industrial problems of Russia. The Russian iron and steel production, meeting the needs of the whole railway net, depended in the past on two huge steel producing districts, the Donez Basin coal fields in South Russia, and the Ural steel industry. The Russian railways, in North Russia, were burning wood, in middle and south Russia coal from the Donez district, and in the far south in Caucasia and Central Asia all locomotives were burning crude oil from Baku. The shipping on the Volga is mainly oil burning and most passenger boats have Diesel engines due to the cheapness of Baku oil. The shipping on the Caspian Sea depends entirely on oil as well as practically all the industries of Caucasia and Central Asia. The steel produced in South Russia is made with mineral coal whilst in the Ural the steel is produced entirely with wood charcoal (as in Sweden) which gives steel of a purer quality (Swedish steel),

Accordingly most of the forests of the Urals are worked to produce charcoal for the steel industry, some timber is produced for mining requirements and railway sleepers, whilst floating of timber down the Volga and its tributaries is mainly limited to building timber and railway sleepers. It might be noted by the way that the river systems of the Volga and the rivers flowing into the Baltic have been connected by navigable canals enabling transport by water between the Baltic, the Ural and the Caspian Sea.

It is likely that with higher timber prices the Ural forests will export large amounts of timber to the Black Sea for the trade in the Mediterranean. The Ural forests are probably capable of exporting nearly as much timber as the Arctic Sea, provided prices permit of part of the carriage being done by rail, and the construction of branch feeding lines becomes practicable.

5. *Siberia.*—In Siberia there are nearly unlimited resources of timber, about one-third of the whole country is covered by forest, but on account of the great distances export can hardly be developed. Through southern Siberia runs the Trans-Siberian railway, but timber prices have in the past not been high enough to permit transport of timber several thousands of miles by rail. The export by water is not practicable since the large Siberian rivers drain into the Arctic and shipping along the northern shores of Siberia, ice-bound for the greater part of the year, has so far not become a practical proposition. Some export has so far only taken place from those districts nearest to the Pacific by the Amur river draining to the Pacific.

As for local industrial requirements exploitation on a considerable scale has been conducted only in the Altai mountains in connection with mining ; the Altai being next to the Urals the most important mining district. Some timber is also used for charcoal for steel production.

6. *The Caucasus.*—The Caucasus being forested chiefly in the hills and surrounded on all sides by the timberless countries of South Russia, Central Asia, North Persia, Armenia and Turkey,

with a large local demand and relatively dense population as compared with the forest areas of Siberia, the Ural, and the White Sea forest area is not likely to develop beyond the local trade with these countries The mountains of the main ranges are covered with fir and pine, oak, beech, chestnut, walnut and even birch and other typically European trees, but the appearance of lianes, orchids, Rhododendrons and Azaleas in the lower hills constitute a different type and in the lowlands towards Batum, palms, orange trees, laurel and wild grapes produce almost a tropical landscape.

7. *Central Asia.*—The forests of Central Asia are quite a different problem. They have nothing in common either with the great European Siberian forest zone, stretching across two continents, nor with the Caucasian forests. I will deal with that part of Central Asia known as Turkestan, or the *Aral basin* as distinct from Chinese Central Asia or Eastern Turkestan, known also as Kashgaria, or more accurately the *Tarim basin.* All the rivers of Turkestan drain into the Aral sea. Probably in pre-historic times the Amu Darya also drained into the Caspian, and still earlier in a former geological age the Caspian and the Aral were one vast sea covering most of the lowlands of Turkestan, and reaching by the "Djungarian gates" (the complete break in the mountain ring of Asia between the Tian Shan and the Altai) to another vast sea covering Chinese Central Asia. Turkestan consists of five provinces:—Transcaspia, Samarkand, Sir Darya, Ferghana and Semirechye (towards Tian Shan and Siberia) and the two States of Bokhara and Khiva both between Transcaspia and Samarkand. The boundaries are in the west, the Caspian Sea, in the south, Persia and Afghanistan, and in the east, the high mountain ranges of the joint Pamir Tian Shan system, separating it from Kashgaria. The northern limit is marked by the Aral sea and the steppes and deserts round it. For geographical purposes (as distinct from the administrative border line) the 54° of latitude could be considered as the northern limit. The southernmost point is on the Afghan border about 35° of latitude. Most of Turkestan is a lowland consisting of steppes and desert with *saksaul* forest in the desert, and agriculture only on irrigated

lands near the big rivers and along the foothills of the high ranges. About one-third is covered by mountains with snowy ranges belonging to the Pamir and Tian Shan systems. The aspect is somewhat different from India. From most of the big towns in the lowlands one sees the whole year round high snow covered mountains and even travelling by railway over a thousand miles from the Caspian to the end of the Ferghana valley in the east—nearly half of the way snow covered mountains form the southern horizon. However there are no forests in the hills below four to five thousand feet. A unique impression of changes of climate and vegetation is obtained on a journey from the Baltic to Samarkand. Probably there is nothing like it as far as contrasts go, even in North America, from Canada to Mexico. I once made such a journey in September. In Petersburg it was cold, rainy and foggy, the train left towards evening and for many hours on both sides of the line poor pine forest, mostly small trees growing in swamps, was seen. Petersburg is surrounded for many miles by pine covered swamps on the low alluvium of the Neva Delta. The next day the forests were quite different, the country slightly hilly, the highest part in European Russia—the Waldai—and the divide of the Baltic and Black Sea river systems. Mixed forest of fir, pine, birch and poplar, large fine trees and few villages or towns. Occasionally large quantities of birch firewood in short lengths are seen near railway sidings. I am in a Pullman car belonging to the Tashkent Railway and at Moscow the car is shunted to the train due for Siberia *viâ* the Samara-Sizran railway bridge across the Volga. After leaving Moscow forests are much rarer, most of the land is under cultivation, many villages and small industrial towns are passed and many small stations; it takes nearly two days to the Volga. The Volga bridge, nearly a mile long on high piers, provides a beautiful view of the huge river, and dense forest growth deep below in the flood area of the river. It is of course broad-leaved forest. Further on high ground not far from the line are large coniferous forests of the regular artificially grown type, hundreds of square miles of trees of uniform size, age, and density, the result of regular State forest management—the last bit of forest before the steppes,

The next morning all trace of forest has vanished, the train is moving fast towards the South and Central Asia. At the Volga crossing it was cold and rainy as is usual in autumn, only the sight of the big river and the forests was cheering. Now it is getting warmer, there is nothing except the endless steppes, no villages or towns; the train goes faster from the Volga by the new Tashkent Railway built at a cost of £20,000 the mile and tested for a speed of 95 kilometer per hour. Stations are rare and far between. The steppe is partly covered in places with *Stipa* silvery waves passing over it, then comes the Aral sea an expanse of water glistening in the sun, the line touches only a corner with a station loading fish, then again the steppe continues, with for a change the high reedbeds of the Sir Darya delta; then start stretches of yellow desert sand covered occasionally with low bushes of *saksaul* and *Calligonums*, until near Perovsk the line passes through some big *saksauls* interrupted by stretches of desert and reeds in the dry beds of the Sir Darya. Further on the sandy desert is displaced by dry loose clay steppe and for the last 400 miles to Taskhent nothing is met except two small towns far off the line. No trees, no cultivation anywhere near the railway. Even the stations are provided with water by pipe lines from the river many miles from the railway. It is towards the evening when on the horizon snow capped mountains seem to hang in the air, the foothills being invisible, all round is still the steppe, no villages or cultivation. Suddenly from nowhere crop up the high steel masts of a huge wireless station, then, (before the War,) one of the largest in the world. The train passes a small irrigation channel, the first running water seen after the Volga, 24 hours ago, and the next moment on both sides of the train are dense gardens of fruit trees, (peaches and apricots), with stately pyramidal poplars along the roads, everything is green and the air full of the aroma of southern flowers. Hardly any buildings are visible, all is concealed by dense sub-tropical vegetation. The train passes rail crossings, connections to sidings with hundreds of passenger cars and goods vans and trains, and still at full speed, a station platform with hundreds of electric lights. In Petersburg some 3 days ago it was cold, rainy, and foggy, when the train left

the huge glass covered station hall, here in Tashkent all are in white summer clothing. The next morning nearing Samarkand the whole southern horizon is one line of snow covered ranges and near the railway rice fields covered with water and an uninterrupted line of orchards and gardens. It is hot as on a mid-summer day. The approach to Turkestan from the west is quite different. On the deep and stormy Black Sea near Batum the vegetation is quite tropical in character, there is no winter, due to a protected position, no frost or snow, and a huge rainfall of about 300 inches in the year. Palm trees on the sea shore, thick jungle of sub-tropical trees interwoven with lianes and wild grapes, open spaces often covered by ferns and moss instead of grass on volcanic red laterite soil and round topped green volcanic hills surrounding the bay. It is part of Lazistan. Then the journey east across Trans-Caucasia with gradually decreasing moisture and the disappearance of forest till Baku, black with the smoke of oil burning factory furnaces. Then the passage across the shallow Caspian Sea to Krasnowodsk in Transcaspia surrounded by treeless rocks and existing only on distilled sea water. And 300 miles more by rail across sandy desert to Ashkabad concealed by green gardens at the foot of the steep rocky Kopet Dagh towering high in the air above the town, on the limit of the desert.

There are in Turkestan 33 forest districts but most of them were only established for forest protection without any expectation of revenue in excess of expenditure. More than half of the forest revenue was obtained from the Perovsk district (Tashkent railway) alone, and a further large amount from three districts in Transcaspia (on the Central Asian railway) all from *saksaul* export by rail to supply the towns with firewood. Most of the other forest districts were concerned only with hill forests, all forests without exception being State property. However the hill forests which commence only at four to five thousand feet above sea level are beyond the distance of economic export ; most of the hill streams are useless for floating and the forest consists only of dendroid juniper, short and thick, good for carpentry, but not for large construction. Therefore the hill forests were exploited only

to cover the needs of the population in the hills. Building timber used in the towns was either coniferous imported by rail from the north or, for minor purposes, Lombardy poplar grown by the local population on irrigated lands for their own needs. Valuable big fir and pine timber is first met in the hills in the north-east corner of Ferghana and in large quantities in Semirechye province in the Tian Shan out of reach of the Central Asian or Tashkent railways. There are two larger forest districts (one near Samarkand and the other near Tashkent) consisting of artificial terraced cultivation to protect bare hills and prevent torrents destroying the irrigated lands below. Therefore so far as hill forest districts are concerned their main purpose is protection to prevent the deterioration of the river systems supplying the country with irrigation water on which the life of Turkestan depends. The main object in view was the development of the cotton crop. There are about 10,000,000 hectares of irrigated land and it was expected by further construction of channels from the Sir-Darya and Amu-Darya to double that amount. All other rivers are completely used up for irrigation before reaching the Aral. The agricultural department had already succeeded within 30 years in displacing practically all the short native brands of inferior cotton by high quality American " upland " with the result that half of Russia's requirements in cotton were supplied by Turkestan and Trans-Caucasia. It was expected within a further ten years to dispense altogether with imports from America and to run all Moscow cotton mills on Turkestan and Caucasian cotton alone. This was Turkestan's big problem with which all branches of the administration were concerned.

(To be continued.)

AN INVESTIGATION INTO THE SUITABILITY OF GOLPATA NUTS OF THE SUNDERBANS FOR THE MANUFACTURE OF BUTTONS.

By Dr. R. L. Datta, D.Sc., F.C.S., F.R.S.E., Industrial Chemist, Department of Industries, Bengal.

This investigation was undertaken in connection with a proposal submitted to the department for the starting of a pioneer button factory based on the utilisation of *golpata* nuts (*Nipa fruticans* Wurmb) as a raw material. The nuts are available in plenty in the Sunderbuns. It has been found that the nuts are unsuitable for the manufacture of buttons and all attempts to season the nuts have failed. For the guidance of future investigators it was thought necessary to publish the results.

As the literature on the palm is very scanty, it has been thought desirable to put on record the nature and habits of the palm. The palm grows abundantly in the Sunderbuns both in the 24 Parganas and Khulna districts. In the latter district the growth is particularly plentiful. It grows along the sides of the water-courses, narrow khals favouring most growth. It is not restricted to the banks of the khals but it has been found to grow in the interior along with *keora* (*Sonneratia apetala*) trees in places which are submerged during the high tide. Periodical inundation by water is essential for the growth of the trees in the jungle.

The tree has a short trunk of about a foot. Sometimes this small trunk is not visible on account of the deposition of mud and silt when it presents the appearance of a cluster of leaves only. The leaves vary greatly in length, 18′ to 20′ leaves can be found in strong and mature trees. The *golpata* leaf cutters who market the leaves for thatching purposes, select and cut those leaves whose individual units overlap each other. Those leaves in which the individual units do not overlap are useless and are not cut by them. Mature plants whose leaves are either uncut or cut only to a slight extent bear the fruits while plants whose leaves are cut too much do not produce fruits at all. This is specially borne out by the fact that the fruits have been found very plentiful in certain tiger infested localities where the *golpata* leaf cutters do not collect leaves.

The trees flower from April to June and the fruits ripen in about 6 to 8 months. The nuts germinate on the tree and do not fall until 10 to 12 months after flowering. It is, therefore, evident that the nuts ripen during December to February and fal off the trees during April to May, as seedlings were observed in October which were about 4 to 6 months old. A small amount of flowering takes place in October furnishing mature nuts during May and June similar to the off season flowering of mangoes and pineapples.

The nuts are formed as a round bunch and bunches have been found to yield a varying number of nuts from one to five dozen. The water in the fruit when quite green is edible having a sweet taste. The fruits are frequently cut by *golpata* leaf cutters and the soft kernel and water contained in them consumed.

The collection of fruit is very simple, a dingi should be used which can navigate the smallest khals and water-courses. The bunches of fruits should be cut off and loaded into the dingi. They can then be carried and loaded into bigger boats for final transport.

The following localities in the Khulna District have been surveyed and first class localities have been found to exist in the plot bounded by Bhola Gang and Sapla Khal, Alibanda Khal and the smaller branch khals, Dudmukhi Gang, Aruabindi Khal and the intermediate plot, Badamtola Khal leading to Aruabindi Khal, Ariabanki Khal. Second class localities have been found to be Chori Khal, Nangli Khal, Myrabola Khal, and its branch khals, Badamtola Khal and Tara Khal, Barasiala Khal and branch khals, Putia Khal, Kalamula Khal, Tambulbania Khal. Smaller quantities of *golpata* palms were found in almost all the other water-courses particularly in Pathuria Gang, Bethmore Gang, Harantana Khal, Sela Gang, Patakata Khal, Supoti Khal, Bhola Gang, Mrigamari Gang, Arwaber Khal, Chachan Gang, Latimara Khal, Jaffa Gang, etc., etc.

The collections were undertaken by the last week of April, again by the 1st week of October, and a further sample was collected by the 1st week of December. In April, it was found that the nuts had already started to germinate and those which had

not already germinated did so within a few days after removal from the trees. The October collection gave the following results :—Of the 77 bunches collected, 10 were found to be entirely green, containing water only, 17 were found to contain water with a little kernel, 23 containing soft kernel with little or no water and 27 containing mature kernel. Of the 52 bunches collected during the 1st week of December, only 7 were found in a slightly unripe condition and none of the bunches was found to be germinating. As already stated, the correct season for the collection of nuts is from December to February after which germination takes place.

The examination of the mature nuts was as follows :—

If the nut be cut into two halves and dried, in the air or sun, the kernel dried, but cracked badly and lost its transparent nature thus becoming unsuitable for making buttons. In some cases fungus growth took place which was evident from the white opaque appearance which the kernel assumed. A large number of mature nuts from each bunch particularly from the December collection were treated as follows :—(*i*) bristles removed, (*ii*) bristles removed and a hole bored, (*iii*) a hole bored only without the removal of bristles, (*iv*) whole nuts untreated. Exposure to sun in addition to keeping in shade was resorted to but it was found that the kernel of all the nuts completely perished due to fungus growth.

It is clear, therefore, that the nuts are unsuitable for making buttons.

not yet separated working plans and research staff from the ordinary administrative staff.

E. A. S.

BURMA FOREST BULLETIN NO. 17—(SILVICULTURE SERIES NO. 13, PUBLISHED IN 1927). VOLUMES OF SINGLE TREES AND VOLUMES AND NUMBER OF TREES PER ACRE FROM DATA COLLECTED IN TEAK PLANTATIONS IN BURMA. ALSO VOLUMES OF SAMPLE TREES OF DIPTEROCARPUS TUBERCULATUS, TERMINALIA TOMENTOSA AND TERMINALIA PYRIFOLIA.

BY G. S. SHIRLEY. 1928.

The measurements made in the course of routine sample plot work have been utilised to derive tentative figures for use till the data are enough to justify the compilation of yield tables. General volume tables are given for teak by 1" diameter (the corresponding girths being given); 10 feet height and 10 year age classes, for standard timber (*i. e.*, down to 8" diameter over bark). The age differentiation we do not remember to have seen before, and it is in fact virtually rejected here, as figures for all ages combined are also given and recommended for use—a course justified in any case by the small number of data available for each class. For each height class also is given the average age, height and length of bole down to 8" diameter. Tables are given for full basal area volumes and also quarter-girth volumes; one wonders if in actual practice quarter-girth volumes are ever referred to diameters.

The crop data—number of stems, πr^2 volume and quarter-girth volumes before and after thinning—with the differences representing material removed as thinnings are read from curves for every year of age as in R. Bourne's Nilambur teak tables with which comparisons are drawn. Nilambur quality classes are accepted for the present, with height against age as the criterion for allotment. The number of stems standing in the Burma plantations is persistently and appreciably higher, though the number on Class II at 70 years is nearly the same. It is a pity

Burma crop diameters are not given for comparison with the Madras figures which are reproduced, and it rather appears from what is written on page 3 that this may have been an oversight. It might have been advisable, when giving the conclusion that on Class II, a rotation of 90 years will only produce a tree of 5′ 2″ in girth (and Class I, one of 6′), to emphasise the fact that the girths given are *mean* girths and that many stems will be bigger, some considerably so.

For the three species of secondary interest, the data are few (the actual number might have been mentioned) but it is useful to have them on record. Standard timber volumes, both on full basal area and quarter girth, are given. For *Terminalia tomentosa* outturn data are also given (quarter-girth) and the percentages assumed to hold for *Terminalia pyrifolia* also. Outturn figures for *Dipterocarpus tuberculatus* and *Terminalia tomentosa* were published in Burma Forest Bulletin No. 15, 1926.

DEHRA DUN : H. G. C.
5th March, 1928.

BULLETIN No. 40—WESTERN AUSTRALIA.
THE SEASONING OF WESTERN AUSTRALIAN HARDWOOD.

By Stanley A. Clarke, B.E., A.M.I.E. (Aust.).

Although limited to the seasoning of Eucalyptus species this report of Seasoning Research in Western Australia is worth careful study.

In air-seasoning practice there is no difference of opinion, as the rules issued by U.S.A. Forest Products Laboratory, Madison, leave little room for improvement and these are the basis for all air-seasoning.

Experiments were started with the Tiemann Kiln and finding it satisfactory in that climate and for their timber, they have continued with thermal circulation. The Clarke Kiln which is described in detail has, however, not copied anything from the Tiemann Kiln and has the very desirable feature of reversibility of

direction of air circulation, which is a point of the Thelăn Kiln now used in Madison.

The chief advantage of the Clarke Kiln is its low cost, there being no machinery required other than steam-pipe coils and simple dampers. It, however, is designed to take advantage of local conditions of material and climate, and will only function under such conditions.

The material appears to be all square-edge boards and can therefore be edge-piled and thus give a free up and down passage to the circulating air. The climate not being excessively hot, allows a good thermal circulation to be obtained from high chimneys (the intensity of circulation depends on the difference in temperature between interior of kiln and outside air), and as it never combines high temperature with high humidity, it reduces to a minimum the amount of circulating air required for drying purposes. Work with such a kiln would be at a standstill during Indian monsoon conditions. The drying schedule for a Clarke Kiln shows higher temperatures and humidities and also a longer time in process than with blower ventilated kilns. The cost of kiln drying is not worked out but from the indications given it would appear to be about 6 annas per cubic ft. for 1 inch thickness. The Chapter on tests is practical and the diagrams are set out in a novel manner, but the actual tests for moisture content and stresses are the usual.

A small oven made of a tin box with two carbon filament electric lamps is described for use in making occasional moisture tests.

The drying schedules are on high temperature, high humidity basis, and are only for Jarrah and Karri. Much more actual steaming is used than has been found advisable for Indian hardwoods.

At the end of the booklet are some notes as to the care of seasoned timber. A reasonable interval for settlement between kilning and use is advised, but the advantage of leaving for many years is deprecated. As some timber drying processes claim to produce the effect and advantages of "age" this is a controversial point.

The necessity of protecting the unseen surfaces and ends of manufactured timber is emphasized and an interesting point is raised as to whether timber re-moistened when fixed in a position not allowing expansion (*e.g.*, a tenon) will shrink further when again dried. As such timber is well protected from seasonal changes the effect is not likely to be great provided the process of manufacture is carried out on timber that is in hygroscopic equilibrium with the climatic conditions when the work is completed.

S. F.

EXTRACTS.

THE "FIELD" AND THE FORESTRY COMMISSIONERS.

We should have liked to end on a cheerful note, and if we were writing only of grouse moors and of partridges, cheerfulness would not be unjustifiable. There is nothing else to be done but to make the best of the situation and to hope for better weather. But partridge and grouse prospects, unfortunately, are not the only subjects which are exercising the minds of many of us. There is the whole future of deer-stalking and of the general sport of shooting over a large area of country which is now affected by the attitude towards wild life adopted by the Forestry Commissioners. Briefly stated, it appears that it is the settled policy of the Forestry Commission to destroy, by any means and at any time of the year, any bird or animal which they choose to regard—whether fairly or not—as harmful in any circumstances to growing timber. Red deer, roe deer, hares, rabbits, blackgame, grouse and pheasants are to be killed down whenever and wherever possible. We do not say that written instructions to this effect have been issued by the Commissioners and their officials to the foresters employed, but we have the best reasons for believing that the foresters concerned know what is expected of them, and that they carry out their unwritten orders. We are not concerned here with the Commission's methods of forestry as regards planting and replanting, and in the purchase of suitable or unsuitable areas of ground, but we do regard it as most unfortunate that there should exist this collision of ideas between a Government department and the followers and upholders of one of the great sports of the country.

We wish we could see light in the future. We shall try to look for it, if it can be found and meanwhile we believe that the best road to take is the collection and publication of facts. We have published some already ; we are collecting others.—[*The Field.*]

SHAKSGAM VALLEY EXPLORATION.

(OFFICER IN CHARGE—MAJOR K. MASON, M.C., R.E.)

An expedition was sanctioned by the Government of India towards the end of 1925 to explore and survey the sources of the Shaksgam river and the Aghil range which lie beyond the Karakoram range. Major Kenneth Mason, M.C., R.E., Survey of India, was placed in charge of the work. His party consisted of Major H. D. Minchinton, M.C., 1st Gurkhas, Major R. C. Clifford, D.S.O., M.C., I.M.S., Captain F. O. Cave, M.C., the Rifle Brigade, and Khan Sahib Afraz Gul Khan (U. S. S.), Survey of India. Three Gurkha sepoys and one havildar from No. 18 Party, Survey of India, were the only down-country personnel employed.

Supplies and fodder for transport were arranged for in Leh and the Nubra Valley; some difficulties were caused on the Himalayan passes by the late spring falls of snow. The expedition, taking the Central Asian trade route as far as the Karakoram pass, reached the headwaters of the Yarkand river at the end of June and crossed into unexplored ground at the source of the Shaksgam on 2nd July, with a caravan of about 160 ponies and 24 Ladakhi porters.

The head basin of the Shaksgam was first explored. The valley was found to be blocked by a large glacier which descends from the northern wall of the Karakoram range, in the neighbourhood of the Apsarasas group and Teram Kangri. A fine view was, however, obtained from the mountains east of the glacier, as far as K^2 and the Gasherbrum peaks, and the valley beyond the block was surveyed by planetable and Wild photo-theodolite. There is no doubt that this valley is a continuation of the one ascended by Sir Francis Younghusband from the foot of the Aghil Pass in 1889. No useful object would have been gained

by forcing the glacier with a small party and merely traversing the ground that could be seen from the stations; and as the ponies were becoming weaker from lack of grass, it was decided to make a new base at the head of a tributary to the Yarkand river, discovered by Major H. Wood, R.E., Survey of India, in 1914.

From this new base, Major Mason took a party across the glaciers at the head, explored and surveyed the barren valleys beyond, and discovered a high plateau, whose existence was previously unsuspected. This plateau was surveyed and a way found westwards to a previously unknown river, which at first was believed to be the middle course of the Shaksgam river; it subsequently turned out to be a large tributary to this river, but the junction could not be reached owing to the amount of water caused by the melting of the snows.

As a result of these explorations about 1,500 sq. miles of previously unknown country have been surveyed on the half-inch scale, and this area will be increased when the topography plotted in Switzerland by the Wild Stereo-Autograph is included. This area includes the whole head basin of the Shaksgam, its upper sources and tributaries, and its first large feeder glacier; a very large portion of the series of parallel ridges of the Aghil range, whose altitude has for the first time been determined, the head basins of the Yarkand tributaries discovered in 1914 by Major Wood, and the Aghil Depsang plateau. Some very fine views of K^2, the second highest mountain of the earth, and of the other great peaks have been obtained. Zoological, botanical, and geological collections have been made and have now been worked out by experts. A complete series of cirrus cloud and other meteorological observations were made, and a detailed examination of the extensions of the range axes was carried out. On the return of the expedition, a quarter-inch survey of the country and glaciers between the upper Shyok and Panamik in the Nubra valley was made by the Khan Sahib, and photographs were taken with the Wild phototheodolite of the lower Nubra. These have now been plotted on the Autograph in Switzerland and it is hoped to bring up to date the existing map of this portion of the trade route. The old 'atlas' map of this district has long been known to be inaccurate.

The whole area explored is extremely barren. Peaks of 21,000 and 22,000 feet are common. The party was for three months almost continuously over an altitude of 16,000 feet, with stations much higher. Grass and fuel were very scanty, and to the lack of grass must be attributed the high mortality among baggage animals. Of 21 ponies bought, ten died from various causes, and there were 20 deaths among the hired animals. The health of the party was good on the whole, but a few accidents occurred. The most serious of these was due to a fall of the hillside, which fractured the skull of one of the men. Thanks to Major Clifford, this man completely recovered, and the party broke up fit and well in Srinagar in November.

An account of the expedition was given to the Royal Geographical Society on 24th January 1927, and published in the "Geographical Journal" for April 1927. The results of the Stereographic Survey Experiments with the Wild Instruments were read before the Royal Geographical Society on 9th May 1927, and were published together with a description of the Autograph in the "Geographical Journal" for October 1927. A full report giving the scientific results, including brief contributions and classifications of the collections by Natural History Experts is now under preparation and will be published in the "Records of the Survey of India."

(*Extracted from the Survey of India, General Report,* 1926-27.)

FOREST REVENUE, BENGAL.

EVERY PICE HAD BEEN WELL SPENT.

Moving that a sum of Rs. 10,62,000 be granted for expenditure under the head "8-Forests and 8A-Forests-Capital outlay charged to Revenue," the Hon. Nawab Nawab Ali Chowdhury said that several motions for reduction had been tabled against the Forest demand. The Forest Department brought in a large revenue every year, which after deducting the expenses, was utilized for expenditure in other branches of the administration—both Reserved and Transferred. This net income—even after taking into account the whole of the capital

outlay—had been about Rs. 12½ lakhs every year, and last year when moving for grants under forests he had hesitated to put before the Council the large increase which he expected, and put the estimate of net income of the current year at Rs. 14 lakhs. This income had turned out to be Rs. 17 lakhs and there could not be any denial that every pice spent had been well spent. A further increase was expected in the ensuing year.

In all works of forest exploitation the first stage was to prepare what was called a working plan—which consisted of marking out a given area of forest into blocks, enumerating the existing trees and then laying out a programme—usually of 10 to 15 years—of felling and planting.

Roads and pathways had next to be opened out and quarters provided for the officers and staff to live in. To refuse provision for outlay on such works would mean foregoing a handsome revenue to the Provincial Exchequer, and stopping further expansion of forest work. It was a pity that only 1¾ lakhs had been available for capital outlay next year as against about 2½ this year and 3½ lakhs in 1926-27. But he hoped there would be no effort to reduce the amount further. The increase in establishment was normal—from Rs. 8,01,000 in the current year's budget to Rs. 8,04,000—but considering the gradual expansion of work it must be said to be very moderate.—[*Statesman.*]

THE COLLECTION OF PLANTS IN THE EASTERN HIMALAYA AND TIBET.

The Proceedings of the previous meeting, held on Thursday the 5th January 1928, having been circulated, were taken as read and confirmed.

Mr. C. V. B. Marquand gave an account, illustrated with lantern-slides, of the collection of plants made by Capt. F. Kingdon Ward in the Eastern Himalaya and Tibet in 1924-25.

Capt. F. Kingdon Ward accompanied the last Mount Everest Expedition when it started out from Darjeeling, then travelling in an easterly direction from Gyantse to Tsetang over unexplored ground, and crossing the Temo La to Tumbatse, he entered the

region in the neighbourhood of lat. 29° 40′ N., long. 95° E. where the most important part of the collection was made. A short distance east of Tumbatse several high passes over the eastern extremity of the Himalaya were traversed. On the highest of these passes, the Nam La, over a southern spur of the lofty Namcha Barwa at an altitude of 17,500 ft., many alpines were collected. In the month of August, 1924, an extensive collection was made around the Trasum Lake, and the Banda La—a pass of over 18,000 ft., the most northerly point of the expedition—was visited. On the return journey through Bhutan several species were found which had not been collected since they were discovered by Griffith nearly a century ago.

An account of the Sino-Himalayan Flora was communicated by Capt. Kingdon Ward to the Society last May and appeared in Proc. Linn. Soc. 1926-27, pp. 67—74.

Excluding the three genera *Meconopsis*, *Rhododendron*, and *Primula*, which are dealt with elsewhere, the collection comprises 446 species, including 54 new species as well as 26 new varieties.

The genera most strongly represented, apart from the three mentioned above, are *Saxifraga*, 26 spp., nine being new; *Gentiana* 16 spp., one new; and *Pedicularis*, 20 spp., three new. Four new species of *Lychnis*, three of *Corydalis*, two each of *Delphinium Impatiens*, and *Buddleia*, and one each of 27 other genera are described as new.

Mr. I. H. Burkill agreed with the remarks made by Mr. Marquand in the course of reading his paper as to the important influence of the Monsoon on the distribution of species. He had found in the Abor Hills that the Indian element in the flora tailed off with the diminishing Monsoon.

Major R. W. G. Hingston stated that in the Mount Everest Expedition he had found spiders at an altitude of 22,000 feet, and asked for information regarding the altitudinal limits of plants in the region traversed by Captain Kingdon Ward.

Mr. H. N. Dixon, with reference to the new genus which Mr. Marquand had stated he intended to establish, pointed out that the name was preoccupied by a genus of Mosses.

With regard to the paucity of Cryptogams in the collection, Mr. J. Ramsbottom remarked that probably a fair number of

micro-fungi had been incidentally collected, and he suggested that a close examination of the collection might yield valuable results.

Mr. R. Paulson stated that he had found on the Rhododendrons in Captain Ward's collection over thirty species of Lichens, and the examination would probably throw light on their distribution.

Mr. G. Tandy, with reference to Major Hingston's remarks, suggested that where animal life had been found plant life was bound to be also.

Mr. Marquand, in reply, stated that Capt. Kingdon Ward did not gather anything above 18,000 feet. It was surprising that Mosses and Lichens should not have been found far above the highest flowering plants in the Himalaya. In the Alps *Ranunculus glacialis* reaches the greatest altitude for Phanerogams on the shoulder of the Matterhorn; Bryophytes occur at a still greater altitude; while he had collected several species of saxicolous Lichens on the summit rocks of Monte Rosa (15,200 ft.). Allowing for the difference of latitude between the European Alps and the Himalaya, where the snow-line is some 9,000 feet higher, Lichens would be expected on Mount Everest to at least 24,000 ft. and possibly much higher, and Mosses should be found to nearly this altitude. This might explain the presence of spiders and insects so high on Mount Everest.—(*Linnean Society of London, general meeting, 19th January, 1928.*)

ANIMAL LIFE ON MOUNT EVEREST AND SURROUNDING COUNTRY.

Major R. W. G. Hingston, I.M.S., gave an account, illustrated with a fine series of lantern-slides, of his observations on animal life on Mount Everest and the surrounding country.

Major Hingston accompanied the Mount Everest Expedition of 1924 as Medical Officer and Naturalist. Collections were made of the fauna and flora of the region traversed, and particular attention was given to the methods by which animals adapt themselves to the special conditions associated with high altitudes.

The environment of a lofty mountain-range differs from an environment at sea-level in certain fundamental particulars. These differences are mainly the lowness of temperature, the intensity of wind, the scarcity of food, the barrenness of the surroundings, and the rarified condition of the air. In order to meet these changes in environment, the animals living at great heights have had to make special adaptations. There have usually been alterations in habit, but we also find modifications in structure.

Altitudinal distribution was specially studied. Fishes and reptiles ascended to 15,000 feet. A varied assemblage of mammals, birds, insects, and spiders was collected at 18,000 feet: Moths, butterflies, and humble-bees were carried by wind-currents to 21,000 feet. Birds followed the climbers up to 27,000 feet, The highest plant was taken at 19,000 feet. Small spiders were found living permanently at 22,000 feet.

The President congratulated Major Hingston on the great interest of his account and the beauty of his photographs. He suggested that the spiders found at 22,000 feet lived on insects blown by wind up to that height. He recalled Murray's observations on the life found in freshwater pools in the Antarctic and on the resistance of creatures like Rotifers and Tardigrades to extremes of temperature.

Mr. H. N. Dixon mentioned that Dr. Somervell had collected a Moss at 19,800 feet and Lichens at considerably over 20,000 feet.

Major Hingston, in reply, agreed with the President that chance-blown insects probably formed the food of the spiders found at 22,000 feet.—[*Linnean Society of London, general meeting, 2nd February, 1928.*]

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PLANTATIONS AND COMPOUND INTEREST.

The object of this note is to examine and discuss to what extent compound interest should be applied to the cost of plantations. Plantations may be divided into several categories as follows :—

I. Plantations which are made regardless of financial considerations for some definite and ulterior object, such as—

(*a*) prevention of erosion, or

(*b*) fuel reserves for the amelioration and general improvement of the surrounding population, and fodder reserves in areas liable to fodder famines.

Such plantations are analogous to protective and non-productive canals, and to strategic railways ; they are created in accordance with a definite policy where indirect advantages expected outweigh financial considerations. I venture to think that a charge of compound interest on such schemes is altogether anomalous, and, to reduce it to a *reductio ad absurdum*, in the course of sufficient time the compound interest would raise the capital value of such non-paying schemes to infinite proportions. Who benefits by this? Government or the proprietor know that the scheme is not paying financially, and the logical method of dealing with the accounts of such schemes is to show the loss annually, and *write it off* annually, (thus keeping the capital account constant), instead of allowing the losses to accumulate (on paper) to infinity. Just as the nett revenue from profitable forests or plantations are absorbed in the annual revenues of the State, so the interest charges and loss on unprofitable plantations should be a charge on the annual revenues.

II. Plantations which are made for profit and financial considerations. These must again be divided into two distinct classes :—

A. Plantations that add to the capital value and revenue producing capacity of the estate.

B. Plantations that are intended to replace the capital being felled elsewhere, and to keep the revenue producing capacity of the estate at a constant level.

These two classes must be considered separately.

A. In this category is included all schemes of afforestation (except protective), the plantations on blanks, savannahs, and the replacement of comparatively valueless tree crops with more valuable species. All such schemes tend definitely to increase the capital value of the estate, and as they are started with the expressed intention of ultimate increased profit or annual income the charging of compound interest on the cost of creation and upkeep is sound. But the correct rate of interest deserves consideration. The custom in India seems to be to reckon 4 per cent. compound interest on forest plantations. If Government or proprietor of the estate did not spend the money on plantations, he could if he wished place the amount on deposit in a bank. What is the best rate of compound interest obtainable for a *recurring* annual deposit of say Rs. 1,00,000 a year, the amount to remain on deposit for 100 years? A mere forest officer cannot solve such a conundrum in high finance, but it seems very doubtful if the answer would be 4 per cent. with equal security. In the United Provinces this 4 per cent. appears to have been fixed arbitrarily by forest officers without reference to finance authorities, and the same may be the position in other Provinces.

B. This category includes many of the most important plantation works in India, for examples the following may be mentioned :—

The teak *taungyas* of Burma, the sal *taungyas* of Bengal, and the deodar plantations in the United Provinces.

In such cases, I venture to think that the financial basis of the plantation work is somewhat different. In practically every case these plantations have been taken up to overcome the

slowness, difficulty, uncertainty, or even impossibility of natural regeneration. Without them, we know that the sustained yield of the forest is bound to drop, and they are, therefore, an important consideration in the present rate of felling the existing crops as laid down in the working plans. Without them, the rate of felling and *the revenue obtained therefrom* would require considerable reduction if we pay due regard to the fundamental principle of forest conservancy, namely the "sustained yield". Once the principle of the sustained yield is admitted, considerations of compound interest acting on the plantation cost are materially altered. Let me illustrate my meaning by a concrete and probably extreme example, the deodar plantations of Chakrata division, United Provinces, which are being made in areas of deodar forest where all hopes of natural regeneration within a reasonable period have been abandoned. Their cost is certainly not less than Rs. 40 per acre, and the rotation is 150 years, hence the initial cost of creation alone at 4 per cent. compound interest will at the end of the rotation amount to the preposterous figure of over Rs. 14,000 per acre. Needless to say, no deodar plantation can possibly pay that. But every acre of successful plantation justifies the felling of an acre of deodar forest, the revenue from which we may, for sake of argument, put at 100 per acre, and the immediate profit to Government is obvious, Government might, if they wished, put the surplus of Rs. 60 out at compound interest, (*but we know they never would*). If the plantations were not made, what would be the result? One school of thought might argue to scrap the principle of sustained yield, convert the forest into a waste of weeds, fell everything, and hand over the full Rs. 100 per acre to Government to put out at compound interest if they wished, (*but we know they never would*). This is the antithesis of forest conservancy and not what we are trained or paid for, and no forester would support this idea. Moreover this alternative ignores our main hypothesis, that Government have a *Forest* Policy, and want a sustained yield of deodar timber for the well being of industry and the community generally, and not a fixed deposit account, and so it is beside the point.

Another alternative is to leave the existing trees until they die, which, for a long lived species such as deodar, might well

average 200 years more, or until they regenerate naturally, which for all we can say to the contrary, might be longer still. This alternative is also bad, since it results in a forest capital earning little or no interest, and ultimately (if natural regeneration fails to appear) a waste of weeds, and at the best it results in an immediate loss of nett revenue and an indefinite postponement of a well stocked crop. Therefore the plantations are justified regardless of the fact that they cannot pay 4 per cent. compound interest. I would venture to suggest that they are justified if they cannot pay 3 per cent. or even 2 per cent. so long as the fellings which they render possible produce revenue appreciably more than the plantations cost. That plantations included in this category pay some rate of compound interest is obvious, for, (putting intermediate yields against cost of tending and upkeep), a plantation that costs, say, Rs. 40 per acre to create, is going to be worth many times 40 at maturity. But the point I am endeavouring to make is that the rate of interest whatever it is, high or low, should not be entirely dependant on the cost of money, or on the world of high Finance, because the creation of the plantation has produced income that could not otherwise justifiably be realised.

To summarise the points raised in this note :—

(1) *Protective plantations* should not be charged compound interest at all, but the annual loss (plus simple interest if desired) be debited against the general revenues of the estate *every year*, and the capital cost of the plantation will thereby not increase.

(2) *Commercial plantations* should be charged compound interest at a rate that financial authorities should decide.

(3) *Sustained yield plantations* should *not* be charged the same interest as (2), but, having at their creation liberated more money than they cost, should be more independent of the cost of money.

The question is inevitably complicated because in plantations one can never get away from the fact that other things than pure finance come into consideration, and a rigid adherence to the above classification is rendered difficult by overlapping of causes. But if these points are admitted, what will it mean in practical forest management? As regards the sustained yield plantations

I can perhaps best illustrate the meaning by a quotation from the latest annual report on Working Plans and Silviculture in Burma; where we read that weedings have been somewhat neglected in young teak plantations "owing to the bogey of 4 per cent. compound interest to be considered, amounting to considerable sums at the end of a long rotation." But if this bogey is an exaggerated bogey, as I have endeavoured to show, it gives a much freer hand in the creation and upkeep of plantations of this class. It widens the scope for such plantations, and renders possible many propositions which a rigid adherence to 4 per cent. compound interest would render impossible. This is the principle that underlies plantation prescriptions in several recent Working Plans in the United Provinces, where, right or wrong, the principle has been adopted of disregarding 4 per cent. compound interest in the interest of *sustained yield.* What the correct rate of interest should be is a problem that we have not solved, but we continue to make sustained yield plantations to the best of our ability in the firm belief that they are earning some rate of interest, and even if it is not 4 per cent. there is no need to worry.

Supplementary Note.—Since the above notes were written, a leader has appeared in the March number of the "Indian Forester," dealing with the same subject, from which I venture to quote one or two points. In that leader, we read:—"our point of view is that in the case of existing forests the cost of replacing a felled crop—whether naturally or artificially—should be charged against the gross sale value and should not be compounded for the length of the rotation." This puts the case for sustained yield plantations very concisely.

So long as the Government have a *Forest* Policy (as opposed to a purely *financial* policy), it is our duty to replace what we fell, by natural regeneration if that is more economical and equally certain, otherwise by artificial plantations, and in the latter case, to quote the closing words of the leader, "we need not be too particular to propitiate the gods who preside over tables of compound interest."

E. A. SMYTHIES, I.F.S.

PRIZE DAY AT THE FOREST COLLEGE, DEHRA DUN.

The annual prize-giving at the Forest College, Dehra Dun was held on March 31st, 1928.

The following certificates and prizes were distributed by Mr. Barker, Chairman of the Public Service Commission:—

PROVINCIAL FOREST SERVICE CLASS, 1926—28.

Certificates.

1. B. S. Chengappah ...	Private Student ...	Pass certificate.
2. Jogendra Nath ...	Bihar & Orissa ...	Ditto.
3. Sirajuddin Ahmed ...	Central Provinces ...	Ditto.
4. *Rishikesh Hardat* ...	*Private Student* ...	*Ditto.*
5. Inder Singh ...	Patiala State ...	Ditto.
6. Jagjit Chand Mehta...	Central Provinces ...	Ditto.
7. Baij Nath Puri ...	Private Student ...	Ditto.
8. Dina Nath Koul ...	Private Student ...	Ditto.
9. Bhawani Charan ...	Bihar and Orissa ...	Ditto.
10. B. R. Misra ...	Central Provinces ...	Ditto.
11. Bhagwan Singh ...	Private Student ...	Higher Standard Rangers certificate.

Prizes.

Silver Medal for Forestry.	B. S. Chengappah	Private Student.
Silver Medal for Botany.	Rishikesh Hardat	Private Student.
Silver Medal for Engineering.	B. S. Chengappah	Private Student.
Silver Medal for Surveying.	B. S. Chengappah	Private Student.
Hill Memorial Prize for Silviculture.	B. S. Chengappah	Private Student.
The Hon'ble Member's Prize for general Proficiency in Forestry.	B. S. Chengappah	Private Student.
McCrie Memorial Prize for Working Plans.	Sirajuddin Ahmed	Central Provinces.
"Indian Forester" Prize for best student not receiving any other prize.	Jogendra Nath...	Bihar and Orissa.

Rangers Class, 1926-28.

Certificates.

1.	Ghulam Rasul	... Kashmir State	Higher Standard.
2.	Hakam Singh	... Bhadarwah State	Ditto.
3.	Kamal Chand	... Jubbal State	Ditto.
	Daya Krishna Bhardwaja	Private Student	Ditto.
4.	Davindra Nath Khanna	... Kashmir State	Ditto.
5.	Jagat Ram Mehta	... Kashmir State	Ditto.
6.	Mulk Raj Sharma	... Kashmir State	Ditto.
7.	Jayanti Prasad Gairola	... Tehri State	Ditto.
8.	Gurmukh Singh	... Dholpur State	Ditto.
9.	Jai Datt Nautiyal	... Tehri State	Ditto.
10.	Hari Kishan Dobhal	... Tehri State	Lower Standard.
11.	Mohammad Yar	... Bhawalpur State	Ditto.
12.	Mulk Raj Dutt	... Kashmir State	Ditto.
13.	Rada Krishan Machama	... Kashmir State	Ditto.
14.	Anand Lal Koul	.. Bhadarwah State	Ditto.
15.	Chong Dorji	... Bhutan State	Ditto.

Prizes.

Fernandez Memorial Medal for Utilisation.	Daya Krishna Bhardwaja.	Private Student.
Silver Medal for Forestry.	Daya Krishna Bhardwaja.	Private Student.
Silver Medal for Botany.	Hakam Singh ...	Bhadarwah State.
Silver Medal for Engineering.	Ghulam Rasul ...	Kashmir State.
McDonnel Medal for best Kashmir or Punjab Student.	Ghulam Rasul ...	Kashmir State.
William Prothero Thomas Prize for the best practical forester.	Kamal Chand ...	Jubbal State.
"Indian Forester" Prize for best student not receiving any other prize.	Davindra Nath Khanna.	Kashmir State.

Mr. Rodger, Inspector-General of Forests, addressed the students and pointed out that the standard attained was, on the whole, only fair. He welcomed the presence of Mr. Barker, Chairman of the Public Service Commission, on the occasion of the prize distribution. The staff and students were afterwards entertained at tea by Mr. Rodger in the beautiful garden of the College.

The following is the text of Mr. Rodger's speech :—

Ladies and Gentlemen,

I have much pleasure in welcoming to the College Mr. Barker, Chairman of the Public Service Commission. You are aware *that the Public Service Commission* was *established by the* Secretary of State for India under the Government of India Act.

In addition to recruitment for the Public Services the Commission disposes of disciplinary cases, and advises the Governor-General in Council on any question connected with the pay, pensions, memorials, provident funds and leave rules, which may be referred to it, and also, when requested by Local Government, gives advice on any matter affecting provincial services. You will understand, therefore, that we are all especially interested in this Commission, and we are very glad that Mr. Barker has been able to come up and see something of the work at the Forest Research Institute and College.

We have now five classes at the College and this is the last occasion on which we shall say good-bye to the Provincial Service students trained here.

Direct recruitment to the Provincial Service class began in the year 1906, when a third year course for selected Ranger students was started, so that they might be qualified for direct appointment as Extra Assistant Conservators of Forests. This course only survived for six years, and in 1912 a separate course lasting for two years was started to train candidates for this branch of the Service. Since 1912, 189 students have completed the course, out of whom 18 have received Honours certificates, and the great majority of the students have found employment either in Government service or in the Forest services of

Indian States. At the present moment former members of the College with a Provincial Service certificate are employed as follows:—

Assam	11
Bengal	6
Bihar and Orissa	5
Bombay	10
Burma	32
Central Provinces	18
Coorg	2
Madras	17
Punjab	18
United Provinces	19
Indian States	29
Colonies	5

We have, therefore, reason to be proud of the work that has been done with these students, and it is only owing to the recent alterations made as a result of the decision to train Indian Forest Service candidates here that the course has been discontinued.

Referring to the 11 students who are now leaving the College all, except one, have obtained their certificates. I am glad to notice that the marks in forestry, which includes silviculture, utilization and working plans, are good, and it is satisfactory to see that most of the students left with a fair knowledge of surveying, forest engineering and botany. In the secondary subjects as a rule, fairly good marks were obtained, and all the students except two, obtained full marks for conduct, discipline, and physical training. The best student in the class is B. S. Chengappah from Coorg. It is a long time since a student from this province has headed the list. Chengappah gets no fewer than five prizes and we offer him our heartiest congratulations on his excellent work. Second in the list is Jogendra Nath from Bihar and Orissa, and he has been unfortunate in being beaten by Chengappah for all the prizes except the "Indian Forester" prize. The Botany prize goes to Rishikesh Hardat and the McCrie Memorial prize for working plans to Sirajuddin Ahmad.

In the Imperial Service class there are at present 18 students and the first lot of 10 students will finish their course next October. Of these only two are Government candidates, two are from Tehri Garhwal and six are private students. One Provincial Service officer from Assam joined the Senior class in November last. In the class of 1927—29 three out of seven are Government students.

In the Ranger class 9 out of 15 have obtained a Higher Standard certificate and the remainder received a Lower Standard. We have from time to time found difficulty in imparting the necessary instruction to Ranger students because some of them especially from the Indian States, have come to the College without being possessed of sufficient educational qualifications. This will now improve as we have reintroduced the entrance qualifying examination.

Prizes among the Rangers are divided fairly evenly, seven prizes going to five students. Ghulam Rasul from Kashmir, who heads the list, takes the Engineering and McDonnel prizes. I am glad to see that three out of the seven prizes go to the Kashmir State as Kashmir has been for some time a most valuable supporter of the College. The Raja of Jubbal's candidate obtained the William Prothero Thomas prize, and I know from personal experience that he will have every opportunity of proving in the State of Jubbal, where the forests are very well run, that he deserves the prize for the best practical forester in the class. The marks among the Ranger class in silviculture and utilization are good, but not extremely so, and in the other subjects, surveying, engineering, botany, mathematics, law, physical science, and accounts, the standard attained is also only fairly good.

In athletics also I am afraid I can only record fairly good progress. The Hockey team did well and won most of their matches, but the Football has not been a great success, and there are only two or three students who have ever handled a cricket bat. The athletic sports were successful, but none of the existing records were broken. I am disappointed to hear that many of the students did not enter for these sports at all, in fact the number who did so was only about one-third. I would ask the students of the College to take more interest in games, both as playing members and as spectators. After all Badminton is not

a very wonderful game for strong, young, healthy men to amuse themselves with.

The students have toured during their course in the forests of the Dehra Dun, Ramnagar, Haldwani, Gorakhpur, Kheri, Pilibhit and Afforestation Divisions of the United Provinces, and Kulu Northern and Southern Plantations of the Punjab, and I have to thank most heartily for the help given to the classes in the forests Messrs. Channer, Whitehead, Howard, Bailey, Hopkins, Stewart, Benskin, Bhola, Rai Bahadnr Tula Ram and Haq of the United Provinces, and Messrs. Mayes, Hamilton, Bahadur Singh and Khan Bahadur Allah Bux of the Punjab.

To all the Instructors and Assistant Instructors and to the staff of the Forest Research Institute I wish to express my heartiest thanks for the trouble they have taken over the training of the students.

Some of you will remember I mentioned to you last year the absolute necessity for you to learn to use your eyes. You should whenever you are travelling by road, river or rail, cultivate the habit of looking about you and noticing what you are passing. You will find after a while that you begin to record in your mind almost automatically interesting details of places and scenery. These details when collected will amount to a considerable stock of knowledge and a suitable use of such knowledge is one of the finest equipments that a forest officer can have. Do not believe implicitly and blindly what your text books say. For instance you may learn out of a book all about the silviculture of sal, but this intricate and puzzling question can only be answered properly from your own experience. I mention sal because it is the tree with which you are all best acquainted. It may be that we have to spend perhaps too much time over sal here but still all of you should by this time be experts in sal, and we cannot send you all over India to become experts in the silviculture of all the most important trees.

When you leave College do not begin to forget about what you have learnt here. I do not say that you should endeavour throughout your lives to become first class experts in geology, law, engineering, botany and so forth, but if you make a point of

keeping up one or two of these subjects in addition to your general forestry technique you will find that this drill has a most favourable influence on the development of your forestry sense and also I may say on your promotion. There is plenty to be found out in about all the most important Indian trees still, and there is no reason why every one of you cannot make a name over such investigations. But you must not as soon as you leave the College get into the way of thinking you have no time for anything but the routine duties of an assistant or a ranger. Even if you only make one private note a day when you are in the forests you will find that you will collect within a year quite a valuable amount of information.

Our Vice-President, Mr. Trevor, who edits the "Indian Forester" will be delighted to receive from any of you articles of interest to foresters in India, and I am sure that he, or any of the Instructors, will be only too pleased to correspond with you on technical matters in which you are interested. The "Indian Forester" is now in its 52nd year, and I would recommend it to the support of you all. Be sure that the whole of the staff at Dehra Dun are interested in your future and will be glad to hear of you at any time.

The following is the text of the speech made by Mr. Barker, Chairman of the Public Service Commission:—

I was much gratified when an invitation reached me to give away the prizes at the Forest College not only because, as I shall presently mention, the Public Service Commission have reason to take a special interest in the work of the College but because I feel it a special honour to appear at an Institution which is associated with and is the training ground for one of the greatest of the Indian Departments and which has so long and so honourable a tradition of service in India behind it.

2. The present is an occasion for congratulations on a year's good work left behind, an occasion for saying farewell to some of those who have been trained here and are going into the world to justify their training, an occasion of some rejoicing and an occasion on which we honour those who have distinguished themselves. But it is also an occasion for something more important

for taking stock of our situation collectively and individually, for asking why we are here and what we are doing and for considering why it was that the Government of India which is not in the habit of spending money without consideration has lavished vast sums in providing India with a Forest College and Research Institute which are without their equal in the British Empire. The audience I am addressing includes the three grades of officers who are proposing to devote their lives to the service of the Indian Forest namely the Indian Forest Service officers, the Provincial Service officers and the Rangers; and it is on the fidelity and efficiency of each of their grades that the welfare of the Indian Forest depends. The majority of you belong to the Ranger class and the security of the forests rests as much on the good work of its rangers as the fighting strength of an army on the vigour of its lieutenants. I therefore make no apology for talking to you all as members of one service, equally interested in all its problems and equally bound to render it good services. I can go even further. The problem of Forest Conservation is world wide and you rank with the foresters of the whole world in your efforts to safeguard the forest.

3. There may be some ignorant people in India who regard the Forest Service as one of many careers open to the educated Indian, a little more arduous than some, a little more honourable than others, not inaccessible in respect of competition and not undesirable in respect of salary. A little hard cramming of text books, a little physical exercise and the young man is provided with his life's ambition a service in which he is sure of an adequate wage while he serves and an adequate pension when he retires. So long as he does not misconduct himself grossly his position is safe and he enjoys the honour which belongs to a servant of Government. As for hard work and strenuous effort a minimum is due to the Government which has trusted him and nothing more than a minimum.

4. I say that this may be the view of the ignorant observer. If any student has come to this College with any such idea as that, I hope it has long since vanished. If any student retains it the sooner he leaves this College the better. The facts are very

different. You and the foresters of the world are recruits in an army which wages a stern, stubborn, unceasing and almost desperate warfare to avert one of the great calamities which could afflict this planet, namely, the dissappearance of its timber supplies. You will remember in the later days of the Great War the peril which threatened the Empire owing to the submarine menace. On the one hand were cargoes of grain coming from distant parts of the world into English ports to save the British from starvation. On the other were the submarines taking their daily toll of the ships, a toll that seemed to increase day by day. For a time the submarines appeared almost to have achieved a supremacy and if that supremacy was once established a disaster was inevitable and the British Empire, as we know it, would have disappeared. How nicely things were balanced, how narrow the margin few knew then though all know now. So it is with the battle which the Forester is waging. Men care little about distant eventualities and the tale that our coal supplies may vanish in a millenium or less excites but little interest. With timber the peril is not nearly so distant. Unless it is averted in time it will be present to our children and the source of deadly alarm to our grandchildren.

5. The days are long since passed when timber and forest were regarded as a nuisance, when it was legitimate to burn down a tree to cook a meal or to consume a forest in order to provide fodder for a cow. The pioneer stalking through the forest with his, like some animal of prey, destroying far more than he could devour, hacking, mutilating and wasting was in my boyhood regarded as a hero. Now he is regarded as malefactor. The world at large has almost learnt a lesson that it must not waste its timber. It has hardly yet learnt the lesson that it must conserve it. In many parts of the world Governments still live in the sublime belief that as fish multiply in the sea and men multiply on the land so trees will multiply on the hill side in the forest without any care or foresight on the part of men and that since timber has always been on the earth it will always continue to be so in spite of every raid that is made upon it. There have always been exceptions and in a fitful way England has been among the earliest conservators of Forests,

Almost the first of the conservators was no less a person than William the Conqueror. He loved the red deer as a father and gave them the New Forest in which to roam. Like Conservators since that time his policy was attacked and his motives possibly misconstrued. He has been accused of caring more for the trees of the forest than for the people of the forest and more for the deer than for either. Every forester knows how easily the accusation is made, with what difficulty it is rebutted ; but that the Conqueror's care was not confined to the red deer is shown by the definition of the forester which is contained in the forest laws. He is "an officer sworn to preserve the vert and the venison in the forest and to attend upon the wild beasts within his bailiwick". The vert I may say means the green things of the earth and the green trees of the forest and if the New Forest is to this day one of the most delightful verts in the British Isles, we must toast the memory of William the Conqueror for it.

6. Before I pass away from this topic I may mention one other English monarch who deserved fame as a forester and perhaps required all the fame he could get. This is Charles I. He enlarged the ambit of Rockingham Forest from 6 miles to 60 and fined Lord Salisbury £20,000 and Sir Christopher Hatton £12,000 for encroachments. I am sure the Inspector-General envies him.

7. In truth in England the need for conservation was urgent. While the strength of England on the sea at the Armada and at Trafalgar rested on its wooden walls, while its strength of land depended, as at Agincourt, on its 6,000 archers armed with bows of English yew, that most slow growing of trees, it was impossible for England to forget its forests. In this iron age the necessity for conservation was for long forgotten. All too late efforts are being made to carry out forestation schemes in England as people have slowly come to realise that a country which is dependent solely on foreign timber runs almost as great a peril as a country which depends solely on foreign corn.

8. In fact if for many purposes iron and steel have replaced the trees of the forest new purposes for which timber is required

have arisen and in some countries, at any rate, the comsumption of timber is actually on the increase. One of the main causes of this increased consumption is the manufacture of paper and the vast circulations which are achieved by the Press at the present day are only attained by the falling of whole forests to supply their need. When I regard the periodical output of printed matter of all kinds which distinguishes this generation, I sometimes wonder whether the need justifies the means in the impoverishment of our timber supplies. There is another purpose for which timber is now being used in large quantities. A quarter of a century ago the only animal which produced silk was the silk-worm but before the poor insect has had to give up the struggle on account of the demands which were made on its spinning capacities, it has had to exercise birth control because there are not enough mulberry trees in the whole world as to provide silk-worms with food that was so necessary if its energies were to have full play. Now silk in large quantities is made out of wood and probably the wood covered legs of ladies of the present day consume quite as much timber as was ever consumed by the wooden walls of old England. So great is the demand for timber for these two purposes that the supplies of soft woods which are used for the purpose are within almost measurable distance of exhaustion. The generations of trees are as a generation of men. It takes 50 years to replace what it takes an hour to destroy and in nearly every country of the world there is serious doubt whether it is possible for the replacement of timber to keep pace with its ever increasing exhaustion. If it is terrible to contemplate the world without newspapers and ladies without woollen stockings this is by no means the end of the dangers to be apprehended. I am not going to enter into the scientific question of the exact effect of forests on climate. There is, however, no doubt that it is very important, and the result of the destruction of forests may be to convert rich agricultural land into desert.

9. I have said all this perhaps rather too great a length because I think the vital importance of the task on which you

are engaged and the magnitude of that task should be more generally realised.

10. At the outset of my remarks I said that the Forest College was of special interest to the Public Service Commission. It is one of the duties of that Commission to recommend to the Governor-General in Council candidates for appointment to the Indian Forest Service. I have nothing to do with the political issues involved in Indianisation but it is the duty of the Commission of which I am chairman to find Indians for the public services. Consequently the more Indians I can find the better pleased I am; and it is a matter of keen disappointment to me if I find the Commission is unable to recommend well qualified Indians for the positions which it is asked to fill. The forest of India are a peculiar concern of the Indians themselves; they form part of the national resources and if the Indians are not prepared to devote the best of their abilities to their preservation they are falling short in duty which they owe not to the Government but to themselves and to their posterity. The Royal Commission on the Superior Services in India said that it should be possible to meet the whole of the normal requirements of the Imperial branch of the Forest Service in India within a reasonable period by the appointment of Indians; and for the present they contemplated that three out of every four places in the services should be assigned to Indians. Now the prime condition for successful Indianisation is the existence of suitable and well qualified candidates for the service.

11. What are the facts? In the year 1926 an examination was held for this service and from the whole of India only 26 candidates appeared. Of these 14 had to be rejected at the outset as unsuitable and only 12 actually sat for the examination. The facts in the following year were a little but not much better. We hear much of the problems of unemployment among the educated and it is absurd to suppose that in the whole of India there is not an ample supply of well educated men who would be capable of serving their country in the Forest Department to the advantage of themselves and of India. I am told that the reason for the small competition is that service in the

Forest Department is unpopular among educated Indians. Far be it from me to give a glowing account of the conditions of services in that Department in order to entice some young man who is looking for a life of ease to enter into it and meet with bitter disappointment. The service is a hard service, a toilsome service, often a lonely and solitary service. It is not a service which can be conducted from the security of an office chair through the medium of pens, ink and paper. It is a service which calls for all the best qualities in a man, unceasing vigilance, constant physical activity, courage under adverse conditions, the power to control men, scientific knowledge of a high order and untiring industry. In other words it is a service well worth joining by any man who realizes that a life which is devoid of hardship and difficulty, a life which is not a perpetual struggle to attain some worthy end is a life which is not worth living. To put it shortly the service calls for the highest qualities of virility and intelligence. Last year I went down to Delhi when the thermometer was hovering round the point of 90 degrees to examine candidates for this service. One of the tests was a 15 miles walk to be finished in the shortest possible time in the blazing heat. I took no part in it myself but I had the pleasure of seeing the candidates come in from their walk and since I have been in India I have seen few sights that have pleased me more. Many of the candidates did the 15 miles within the three hours. I think all completed the walk in considerably less than four hours. I had expected to see a number of young men almost dropping with fatigue and utterly tired out. Instead I found myself among a gay laughing excited group well pleased with their effort and looking as if they could repeat it without difficulty and calling loudly, as was only proper, for drinks. After that I had no doubts about virility. I wish I could say the same about intellectual qualifications but the fact is that we experienced great difficulty in discovering young men of the intellectual standard required in this great service. We found even more difficulty in finding candidates who possessed other qualities required in a forest officer, keen powers of observation and a vivid and acute interest in the sights and sounds and doings in this world of ours which, with all its defects, is a very

interesting world and the only one of which for the present we are likely to have any experience. To the forest officer it is little use acquiring book learning if, as he moves about the world, the sights he sees and the sounds he hears tell him less than they tell to the least intelligent of the animals which roam through the forest.

12. So I should like to say to the young men of India who complain, not without reason, that in spite of a fine education and a first class degree, that they cannot get employment, that the Forests of India give them their chance. But only on one condition that they are prepared to put the best of their brains and the whole of their energies at the service of their country. If they are men that is a thing they will be glad to do. They will join a great and honourable service with splendid traditions of self-sacrifice and service to India behind it. It is for them to shoulder the task; and if they devote to it unremitting attention and perform to the utmost of their abilities the trust which is committed to them their posterity will arise and call them blessed. But if the forests of India suffer in their hands through inertia or sloth—whether mental or physical—their posterity, as it surveys a land impoverished by their negligence, will call them to account and will curse them with one of those picturesque oriental curses which will bring home to them better than any words of mine the extent of their wrong doing.

SOME ASPECTS OF FORESTRY IN RUSSIA.

BY V. PELTS.

(Continued from pp. 290—301, May number.)

The conditions of the forest work in Turkestan primarily depend upon the following:—

The settled population are owners of their lands and live either in the lowlands of South Turkestan on irrigated lands or in the hills above four to five thousand feet, on lands depending on rainfall.

In the north or rather north-east of Turkestan (towards the Tian Shan) unirrigated agriculture becomes practicable also in the lowlands at least in part. The nomads, until settled, are by

law "perpetually" entitled to graze on all free State lands, in other words, in most forest districts they can graze free of charge, both in the desert and in the hills. However in some valleys the grazing is taxed and some valleys are closed entirely. Flocks of sheep or cattle belonging to the settled population have no right of pasture on State lands. The settled population (except in Transcaspia) are called Sarts; some are Uzbecks or Tadjiks. The nomads are known as Kirghiz, but those in the lowland describe themselves "Kazak-Bala," whilst those in the mountains are "Kara-Karghiz"; often they refer directly to the name of an ancestor of a smaller tribe.

In Transcaspia are the Turcomans (Akhal-Tekke and other tribes). They are semi-nomadic and have usually a garden or even agricultural land, but at the same time they also migrate with their sheep and camels. There are also some Kirghiz in parts of Transcaspia.

The nomads live in tents and burn as fuel wood or shrubs. At the same time they make charcoal for export to villages and towns where the Sarts need charcoal to warm themselves in winter round their "Sandals" (a special device of their own). The European population, however, uses only two kinds of fuel, either *saksaul* transported by rail, or "fruit wood" (wood from old apricot, peach and other orchards) abounding in all villages. Mineral coal is very rarely used, *saksaul* being preferred.

Accordingly the main items of forest revenue are :—

1. *Saksaul* by rail for towns.
2. *Saksaul* burned locally by the nomads for their own needs.
3. *Saksaul* exported as charcoal by the nomads.
4. Jungle ("tugai") wood for tent construction.
5. Jungle wood as fuel.
6. Mountain timber for local construction (Juniper).
7. Juniper as fuel.
8. Juniper for charcoal.
9. Grazing in the hills in forests.
10. Grazing in forestless highlands (Alai, Chatkal).

The total consumption of *saksaul* can be estimated as follows :

100,000 tons exported by rail. (Market value £200,000).

200,000 tons burned to charcoal and supplied directly to towns and villages by caravan.

700,000 tons burned by nomads for heating tents and cooking.

Total 1,000,000 tons per annum.

The consumption of juniper timber in the hills of the south and other hill timber in the north east can reasonably be assessed at 1,000,000 tons. A large amount is consumed free of charge, and is not on record.

To understand the heating problems we must consider the conditions of life of three elements of the population. The European population heat their houses by standard iron stoves consisting of an outer iron shell of 3 to 4 drums joined one above the other, about 1 yard in diameter and 4 to 5 yards high, lined with brick to retain the heat, and with hermetically closing cast iron doors. Fuel consumption per room 4 × 5 metres is about half a ton of *saksaul* per month—very economical.

The Kirghiz live in tents; tents developed during thousand of years to a standard identical from the Caspian to Manchuria; and certainly one of the most beautiful things man ever invented. A good tent costs from £30 (smallest size) to £100. It looks like an overturned tea cup and is perfectly round. The diameter of the large type is about 7 yards and the height 2 to 4½ yards ; the walls rise perpendicular with a graceful " S " like curve ; the top is flattened with a smoke outlet in the middle. The tent is constructed like a basket, of standard collapsible parts of wood connected by leather strings ; it is covered with several layers of half inch thick white-grey felt ; there are no posts or supports in the middle. Inside along the walls and on the ground are carpets. A *saksaul* fire with its powerful radiating heat keeps it very warm with no trouble from the smoke.

The Sart who lives only in towns and villages does not heat his rooms even in midwinter. He uses wood only for cooking ; to keep warm he has his own device—the "Sandal." In the middle of each living room is a ditch and in it he puts a brass or iron tray with charcoal ; above the tray is placed a low table 2 feet

square covered with an immense cotton filled blanket, about 10 to 12 feet square. The blanket is used as a table-covering and a wrap; food is placed on the table on top of the blanket and the Sarts sit round on the floor with the blanket pulled up to their throats. A few pounds of charcoal will suffice for a whole night.

The forest districts in Turkestan can be classed into six types:—(1) the desert forest districts with high revenue working mainly by rail export of *saksaul* firewood; (2) the desert forest districts exploited for the local needs of the nomads and surrounding Sart population (fuel and charcoal); (3) protected afforestation districts for railway protection in the desert; (4) protected artificial terraced plantations in the forestless foot hills to protect catchment areas; (5) hill forests in the Pamir system (juniper) with partly restricted grazing; (6) regular mountain forests of European type (fir, pine, walnut, spruce) in the Tian Shan system and adjoining ranges—at present of little profit.

The desert forest districts include usually, besides *saksaul* forest, also some part of the lower reaches of one of the two big rivers, with thick jungle in the flood area a few miles wide and often a hundred or more miles, long known as "tugoi" and consisting of two elements:—broad leaved trees (*Populus euphratica*, *Salix* spp., *Elaeagnus hortensis* and others), and numerous *Tamarix* species (practically leafless).

In all forest districts, except those exporting by railway, the main factor determining revenue is the hunting down of offenders, and subsequently the percentage of convictions in court. The railway export business is probably near the limit of perfection and efficiency, no offence affecting revenue being possible either by traders or forest servants. Quite the reverse is the case in all other districts. The lumber prosecutions in all districts run usually to 1,000 or more per annum. The law is clear enough, but its application in Central Asia with its vast distances, the usual insufficient evidence against the small offender, and the fact that there are too many camps and many other factors, make it a permanent problem of dispute between the judiciary and the administration.

No one can say that the pilfering of a few pieces of wood by children and women encamped near a forest, can be classed as

serious criminal offence. Even in European forests such cases are not prosecuted beyond the real limits of a civil case, that is to say to the extent of a fine not exceeding the triple value of a forest material concerned; and only repeated offences, by the same individual within the same year lead to proper criminal prosecution with prospects of heavy fines or even prison. The result is that people living near forests may take tons of forest produce without being compelled to pay for it, and with vast distances there is no hope of recovering more than a small amount of the value.

A permit is issued on the presumption that a family consumes on an average five tons of cheap dead timber per annum.

Since the Russian law (as most European laws) is systematically worked out on the basis of the classical Roman law, on systematic principles, as distinct from the English law built up on precedents, this leads directly to the fundamental issue, as to what is an offence or civil case and where proper criminal law starts. This question is of prime importance in forestry, because the forest officer comes daily in contact with all sorts of things up to the murder of forest guards. Formally all forest offences concerning removal without a permit came under the criminal law whilst small excesses against permits and such like came under the civil law. Especially in Turkestan this aspect of forest work is of extreme importance, since the old customary laws of the nomadic tribes have been left in force to a large extent and most of the important factors of forest administration must be considered in the light of the past history of the land. On the top of the list of crimes, West European Law usually puts murder, this being the most prominent of crimes from the point of view of irreparable consequences; facts in East Europe and Asia, however, do not support this view. It might be little known that murder was under Russian law, during the last fifty or sixty years, not punishable with death. Some misconception on this point abroad is due to deliberate misrepresentation by *red* intellectuals who habitually mixed up reports of trials of political bomb outrages and riots with tales about regular law as practised in the law courts in peace time. Only under declared martial law, or in cases of distinctly political murders, when dealing with political

fanatics, could the death penalty be administered. The surprising fact is that the abolishment of capital punishment some sixty years ago did not increase the incidence of murder at all, as is clearly shown by statistics, whilst every instance of laxity in punishment of all other crimes has always lead to the increase of offences. Also the customary law of the desert in Turkestan, with the Kirghiz, has always considered murder as an offence redeemable by payment to the family or tribe affected, and murder has never been a common offence between them except in condition of warfare. In Transcaspia the Turcomen had been for centuries plundering Northern Persia on a scale compared with the Pathan on the Indian frontier, and in comparison the Pathan is a mere child; a whole Persian army of 50,000 was captured and sold in the bazar in Bokhara at a price down to six shillings per head; but since the day the battle of Geok Tepe was fought they have never caused Government any embarrassment. Their ferocious past record of having sold during a century more than one million Persians in the bazars of Bokhara did not cause any hereditary increased incidence of murder in Transcaspia—one did not need to be armed to go about even the frontiers, notwithstanding the fact that practically every Turcoman has a rifle, and that disarmament by Government has been practically discontinued since the time of conquest; it having been proved that the nomadic tribes are perfectly loyal to Government, and that firearms did not increase crime.

The events of the revolution have fully supported this conclusion. The only anti-*red* forces in Turkestan were the Turcoman and Kirghiz, the former fought over a year in support of Government, and in the Caucasus the Aderbeijan Mohammedans and Mohammedan mountaineers, who had for centuries been living on plunder, were the only reliable anti-*red* elements in support of law and order for nearly three years. As a matter of fact of all the Caucasian peoples they were the only element supporting law, and Aderbeijan was the only part of the Caucasus where Government in all branches was carried on without change till the spring of 1920 by the same officials and institutions as before the War, Baku being the only place where

red disorder had occurred due to the smaller Mohammedan element. So far as the forest service is concerned all forest officers in Aderbeijan were quite comfortable till 1920, three years after the revolution had occurred in Russia.

I do not remember any forest officer ever being murdered by the Kirghiz, there were cases with forest guards but none with officers. The nomad makes a big difference between master and servant. Even during two recent disturbances on record—the one in Khiva, Turcomans against the Khan of Khiva and his officials, and the other in Verny, Kirghiz against European peasant colonists—forest officers of the gazetted class could go about anywhere. The nomad has an inborn respect for any one he considered master or leader, as apart from servant.

There is also another element in Turkestan—the Sarts. Ethnographers have been at a loss to determine their origin and it is a fact, that they live only in towns and have no name for their nationality. They refer to themselves as Tashkent-lik, Samarkand-lik, and alike, meaning that they are the inhabitants of a certain town or village. No nomad will express himself like that, he involves the name of his ancestor or tribe. The nomads tell another story about the Sarts. They say between themselves, that the Sarts were surprised at not being massacred when Turkestan was occupied, and expressed the opinion that *Allah* (God) must have blinded the Europeans to save them. This shows the tremendous difference in the psychology of the nomad, the free man of many ages, the past master and conqueror of Asia, and the settled town inhabitant who had been massacred regularly as a matter of routine and expediency by each conqueror. History repeats itself and the inhabitants of towns are the various elements descending from the servants and retainers of past conquerors and captured slaves who settled down, and other mixed people who lost their free traditions; stuck to the soil they tilled and submitted to any one who had the stick in his hand. Each new conqueror mistrusted them; they always submitted to every maltreatment no nomad would stand, and regularly there came a time when they suddenly made a miscalculated rising, always at the wrong moment, to be suppressed

again by a new master. The nomad was different. If he did not like a new regime, he migrated, otherwise he supported loyally the new power in the land. Since the battle of Geok Tepe which decided things and cost more lives than all the wars of 20 years in Central Asia the Turcoman has been perfectly loyal.

Nearly the same can be told of the Kirghiz who did not participate in the war but was quite able to move off to Chinese territory as he had done occasionally in the past. He had been a troublesome fellow for centuries, but settled gradually down when the raiding of caravans became impracticable but he still thinks the Sart is good game for him. He understands perfectly the point of view of any official or the forest officer who come *in contact with him, but he does not and will* not understand either the Sart or the European peasant colonist, a European forest ranger or any other low class European. He misguides every traveller and lies, one should say mostly for the pleasure of fabulating, but does not mean any harm, he never pretends to be a honest person, but when he knows you and has got some respect for you he will suddenly say something you know to be the truth, and not only he, but his whole tribe, may deal with you as straight as you could never expect from a whole European community. Quite different is the Sart, he will play no pranks with you, he is always the perfect honest man and strictly observes his religion to the letter, he will never admit having told a lie. Most Europeans in the towns believed the Sart to be the safe peaceful man of the town whilst the nomad was the lawless fellow. But the fact is there were two sudden risings of the Sarts, one in Ferghana long ago and one in 1926 in Djizak. Both very small affairs, on both occasions no reasonable grievance could be found, and in both cases the trouble was a tornado in a tea cup completely miscalculated as to success. They thought that the whole country was rising and the days of Government were numbered but nothing happened beyond the small district concerned. They displayed a tremendous amount of fanaticism, bloodthirstiness and cruelty, but within 24 hours the whole affair had been suppressed and they had themselves even delivered up their own leaders, a thing no nomad has ever done.

Within a few days they were as holy and peaceful as ever before, no trace of discontent could be discovered.

The same could be observed in Bokhara. The Emir of Bokhara several times appealed to the Governor-General for help. He could not manage his own subjects—not the unruly Kirghizs but his own people the Sarts who were defying him. As a matter of fact the Emir himself has come to be considered a Sart having lost the nomad traditions, although by origin he is as any other ruler before him of a semi-nomadic Usbek tribe.

All the *saksaul* forest business in Turkestan (except Transcaspia) is within Kirghiz territory. The main items, as stated before, are *saksaul* for export by rail, *saksaul* burned for charcoal to be exported by caravan to the towns and villages for sale to Sarts, payment for fuel locally used by the nomad, and a few smaller items.

To explain matters I will recount a few experiences in the southern Kizils-Kum desert in the Djizak district (without export of *saksaul* by rail), and afterwards the business in Perovsk in the northern part of the Kizil-Kum desert (export only by train). When I arrived in the Djizak district I went straight to the western end on the borders of Bokhara some 200 miles away and assumed complete inactivity for half a year. Two years later the revenue of the district was triple and I was on the high road to success. In another district I doubled the revenue and within a few years got charge of the leading district of the whole of Turkestan—the Perovsk—with nearly half of the total forest revenue of five provinces. The beginning of success was due to the events which happened there on the border of Bokhara where I vegetated once for half a year without showing any signs of life and was due largely to my Kirghiz forest rangers.

I was then an assistant and all assistants had fled from that place in the desert as soon as they could. Being a naturalist I got interested in the desert problem and some years afterwards it was said that a Colonel of similar taste and myself were the only persons who knew the "soul of the desert".

First the Kirghiz decided to mislead me, for the fun of the thing, as they had always done with all successive assistant

before. It was a tradition to do so, then I mastered the art of tracking caravans in the desert hitherto unknown to Europeans, but without showing any interest in the activities of smugglers, until suddenly I descended upon the frontier in a grand raid. I confiscated within a few weeks three thousand camel-loads of smuggled charcoal. Usually each caravan consists of 20 to 70 camels. Next winter the smugglers were more careful, it was much harder, but I again caught several thousand camel-loads by the tracking of caravans across the desert.

That settled things. The nomads had thought it quite impossible for a European to penetrate their secrets and to appear from nowhere, hundreds of miles in the desert, without so much as a rumour. One result was the triple increase of revenue from burning charcoal for export to Bokhara and Samarkand. The people had decided once and for all not to burn charcoal without permits, as long as I was anywhere near.

The other result was that the Kirghiz of the desert decided to abandon all tricks so long as I was about, as it was no use, and they became perfectly straightforward with me. The people in the neighbouring town in Bokhara Nur-Ata across the border went even further, they did not become honest, this was impossible, they decided that my Zeiss binoculars could see through walls any caravans concealed anywhere in the bazar and humbly paid fines for stolen charcoal, it being impracticable to defy that sort of magic.

The next year I was able to stay in the town (Djizak) without having need to go to the desert. The Kirghiz had made up their minds to live with me in peace and to be honest and I had all the information I wanted without leaving town. There were a few European rangers and two of them started some malpractices thinking news could not reach me two hundred miles away. They did not know that news passes across the desert in no time.

Any thing they did I knew within a few days, they had the common conception of Asia, and did not guess that truth exists in Asia at any rate with the martial tribes. They were misled each time, and made fools of, all their adventures were regularly report-

ed, not as complaints, but as correct and accurate news, and when their time was up, and it was decided to dispense with their services, it became necessary for me to go on inspection to procure all the facts in case prosecution was decided on. I went through their districts and of course they had to report to me, as is the rule when a superior is on inspection, but they could not find me for two weeks, they did not know the desert and heard about me always too late. I knew daily where they were what they were doing, where they went to find me, and obviously they were misled by the whole population. Having seen enough of their incompetence I sent a Kirghiz ranger with orders for them to meet me at a certain desert well, a few weeks later. When the ranger came back I overheard a conversation outside the tent. The ranger, a Kirghiz, was telling his observations to another.— " I told the two fellows, the assistant is inviting them to a cup of tea. The other being more kind hearted depreciated such a joke. Again the first said. 'But they are not men, there is the famous horse-thief, Tutka Bai, he is at least a man, there is the Colonel Skwarski of the administration, he is also a man, he did much good to our people, but these two are not men, they are only rubbish, they can neither do any good, nor any harm,—just rubbish '."

That was the opinion of the desert about the two European rangers. And it illustrates the nomads' respect for any force whatever evil or good so long as it is really a power, not from the fear of such force, as is the case with settled population who cannot escape, but from just admiration as compared with disrespect for the man who can do neither good nor harm. It is usually the case, that all complaints lodged against forest subordinates are cooked, and entirely untrue, and normally the complaints are greatest if the man is really doing his job. With these two it was quite different. All I had heard in town was perfectly correct, there were no lies reported. The evil-doers were the laughing stock of the desert, they were misled all the time and could not find me till I went myself to the well at which they had been ordered to meet me. They confessed and accepted at once the terms of dismissal.

The smuggling of charcoal is practised by the Kirghiz as a sport. He does not see a crime in it, and I did not make any trouble if fines (triple value) were paid. There was no ill will as is the case when you catch forest offenders in European Russia, or anywhere else in Europe. The Kirghiz is in that way a gentleman, he quite sees your point of view as representing Government, and next time you meet quite friendly as old acquaintances, and he is even ready to buy charcoal you have confiscated from some one else. As to the Kirghiz forest rangers they can be trusted with any Government money. For instance once a shepherd of the desert turned up at my office with letters and documents from a ranger. He put on the table some £300 in money from sale of permits, a fortune for him, and whilst I went to the office to call the clerk he went away. He did not want a receipt for the money neither did the ranger who had sent him, both had full mutual confidence.

There are cases in administration when one obtains new ideas on the question of what is the real nature of crime. A Kirghiz is not a strict Mohammedan until he is old enough to think about death. It may happen that a Kirghiz forest guard takes to drink which is an offence against his religion, but it has been found that it is hardly necessary to dismiss him, he can easily stop it, and usually does so when older, no great harm is done and rarely does he neglect his duties. There are few Sarts in the forest service, (they are never much good), and if one of them takes to drink it is necessary to dismiss him at once. Where does the difference lie? Well, if a Sart takes to drink he will never stop it, and will commit any crime to obtain it. The reason is simple; the Sart adheres to his religion literally, and never misses any prayer. Once he has touched drink he loses all self-respect and the respect of the population, he has no will power left, having lost his habit of an honourable life, the only limits to the crimes he will commit are those dictated by cowardice. The obvious conclusion is, when the Kirghiz touches drink it is only a minor offence. When the Sart touches drink it is a first class crime.

The conduct of forest work in Perovsk is probably quite unique. The *saksaul* gathered by the Kirghiz is brought by camels to the railway, sometimes in the season as many as 20,000 to

30,000 camels are employed. All *saksaul* corresponding to the specifications permitted is passed for loading. The exporters obtain from the forest office permits to load a definite number of railway trucks, and deposit at the treasury, to the credit of the forest officer, a minimum charge per truck plus a deposit to cover the excess loading capacity of the trucks. They get from the forest office against treasury receipt or cash, the transport permits for each truck in duplicate. The Tashkent railway, as also the Central Asian lines are strictly prohibited from accepting any *saksaul* or other forest material without a permit from the Chief of the District, or the nearest senior Forest Officer. The assistant of the station master together with the forest ranger on duty attend the weighing of the trucks. The first copies of the permits with weights stated are returned to the forest office, and the actual loading capacity shown is entered in the books against the deposits of the exporters. Any deposit remaining in excess is credited for further purchases of the exporter. Occasionally to prevent any malpractice—for control purposes—trucks are reweighed suddenly *en route* or on arrival in Tashkent. The result is that offences have been made practically impossible.

The area of exploitation is up to 30 miles on both sides of the railway. The transport to the railway by caravan costs up to 14 shillings per ton. The royalty paid to the Forest Department is also about 14 shillings per ton and the transport to Tashkent (about 500 miles) costs a further 10 shillings. The cost price of the *saksaul* delivered in Tashkent is, therefore, normally not above £2 per ton, often much less.

(*To be continued.*)

THE GROWTH OF HEMLOCK BEFORE AND AFTER SUPPRESSION (HARVARD FOREST BULLETIN NO. 11)

BY ROBERT MARSHALL.

The examination of certain stands of mixed hemlock and white pine in Massachusetts, U.S.A. has led to some interesting conlusions bearing directly on the silviculture of the first named species, and suggestive in regard to other shadebearing conifers. The stumps of these trees show central cores of from 1 to 5 inches in diameter, recording upwards of 100 growth rings, succeeded by abrupt changes in rate of growth. Old logging scars coinciding with these changes indicate fellings at those dates. The narrow cores point to a period of suppression, at the end of which a felling in the overwood took place, followed by rapid expansion in the understory thereby released. One typical area was found to consist of four distinct forest stands, ranging from pure hemlock to pure white pine, corresponding with four distinct fellings in the last century. The pine which was self sown since the original fellings was all under 100 years old while the age of the hemlock varied from 70 to 270 years and bore no relation whatever to diameter. A large number of measurements taken partly on stumps and partly by increment borer established a general ratio of 1 to 5½ between the increment for 40 years before and 40 years after release.

The recovery of the hemlock after release was affected by several factors of considerable interest:—

(*a*) The density of stocking of the released trees. A well stocked group exhibited a 60 per cent. better recovery than a sparsely stocked one. Good stocking connotes better quality as well as quantity and results in increased growth in individual trees; dense advance growth left after logging preserves the soil factors and prevents the entrance of faster growing light-demanders which would soon recommence suppression of the hemlock.

(*b*) Abnormal periods of rainfall and drought following release have an effect on the recovery, but only in the drier localities, and for the first decade only

the effect disappears with longer periods. The most suppressed trees show the best correlation with rainfall because their root systems have the poorest development and reflect consequently any dissication; their deficiency in sunlight must be made good by increased moisture.

(*c*) In identical conditions of environment suppressed trees in every case, provided the suppression is not prolonged beyond 60 years, outstrip, after their release, trees which have been open grown throughout. This is probably due to the entrance of white pine wherever the canopy is open. Moreover the conditions of coolness and dampness which are suited to hemlock are precisely those which obtain under suppression.

A further theory to account for this phenomenon is suggested by animal rickets and plant etiolation. Differentiation of tissue, upon which maturity and senility are consequent, is produced by irradiation. The open grown hemlocks mature by the light to which they are exposed, while the suppressed ones retain a youthful quality which enables them to respond readily to release from suppression and to maintain a higher average growth than their open grown companions.

The silvicultural conclusions which emerge from consideration of this phenomenon are, firstly, the importance of preserving advance growth of hemlock, where this is not too scattered, and filling the gaps, where such exist, with white pine. Unsuppressed hemlock shows a rapid decrease in increment, and sixty years should be the maximum rotation employed. Secondly, in producing the required effects, the author claims certain advantages for the Group Selection System in preference to any other. Under this system dense reproduction is easier to obtain; the lateral shade, while admitting light enough for survival, maintains the necessary condition of suppression, and the soil moisture is constantly preserved.

EXTRACTS.

COCHIN AND ITS FORESTS.

[*Extracts from the Report on the Administration of Cochin for the year 1102 M.E. (16th August 1926 to 16th August 1927)*].

INTRODUCTORY NOTE.

Cochin is a Feudatory State on the west coast of India. It is on the north, north-west and north-east bounded by the Malabar District of the Madras Presidency; on the south-west by the Arabian Sea; and on the south by the State of Travancore. It lies between 9° 48' and 13° 50' N. Lat., and 77° 5' and 76° 58' E. Long., and according to the cadastral survey of the State has an area of 1417¾ sq. miles, of which about 593 sq. miles are forests. The forests contain teak, ebony, blackwood and other valuable trees. The State enjoys the benefit both of the south-west and north-east monsoons.

The population of Cochin, according to the census of 1921 was 979,080 of whom 482,959 were males and 496,121 females. The majority, 66 per cent. are Hindus, Christians forming 27 per cent. and Mahomedans 7 per cent. There is also a small community of Jews numbering 1,167. More than half the population is employed in agriculture. Rice is the staple food of the people.

Very little is known of the early history of the State of Cochin. According to tradition, the Rajahs hold the territory in right of succession to Cheraman Perumal who sometime about the beginning of the 9th century is supposed to have governed the whole country of Kerala—from Gokarnam to Cape Comorin—at first as Viceroy of the Chola kings and later as an independent ruler. In 1502 the Portuguese were given a strip of land near the port of Cochin and in the following year they were allowed to build a fort at the place and to establish commercial relations with the State. In the earlier wars with the Zamorin, the Rajas of Cochin derived considerable help from the Portuguese. About the latter part of the seventeenth century, the Portuguese influence began to decline on the West Coast, and in 1663 when

they were defeated and ousted from the town of Cochin by the Dutch, the then Raja entered into a fresh treaty with the latter and conceded to them the same privileges as to the Portuguese. About a century later in 1759, when the Dutch power began to wane, the Raja was attacked by the Zamorin of Calicut who was expelled with the assistance of the Raja of Travancore. In 1776, the State was conquered by Hyder Ali to whom and subsequently to his son, Tippu Sultan, she remained tributary for some time. In 1791, a treaty was concluded between the then Raja and the Honourable the East India Company by which His Highness agreed to become tributary to the Company and to pay a subsidy of Rs. 1,00,000 annually in consideration of the protection promised by the Company from outside invaders. In 1809, this treaty was revised and a fresh treaty entered into under which in addition to the previous subsidy of one lakh of rupees, the State agreed to pay an annual sum equal to the expenses of maintaining one battalion of native infantry, *viz.*, Rs. 1,76,037 or Rs. 2,76,037 on the whole, the amount to be paid in six equal instalments every year. In 1818, this annual subsidy was reduced to Rs. 2,00,000 and the latter forms the pecuniary obligation of the State at the present day.

His Highness Sri Sir Rama Varma, G.C.I.E., the present ruler of Cochin, was born on the 6th October 1858 and ascended the *musnad* on the 7th December 1914 on the abdication of the rulership and retirement into private life of his uncle, His Highness Raja Sri Sir Rama Varma, G.C.S.I., G.C.I.E. The family follows the Marumakkattayam or nepotic law of inheritance and succession. Her Highness Ikkavu Thampuran, Senior Rani, the oldest female member of His Highness' Marumkkattayam family was born on the 19th June 1841, and Rama Varma, Elaya Raja, or the heir apparent, on the 30th December 1861. There are, besides, 137 male and 136 female members in His Highness' family.

For administrative purpose, the State is divided into six taluks, *viz.*, Cochin, Kanayannur, Mukundapuram, Trichur, Talappalli, Chittur and Cranganur. The last is a sort of Zamindari or estate owned by a Chief of the place subordinate to Cochin. The chief towns are Ernakulam (the capital), Mattancheri, Irinjalakkuda, Trichur, Vadakkancheri, Kunnamkulam, Chittur and

Cranganur. The administration is conducted in the name, and under the control of His Highness the Maharaja. The Diwan is His Highness' Chief Minister and the Chief Executive Officer of the State, with whom the Agent to the Governor-General and the heads of departments correspond in all official matters.

FORESTS.

Area.—The total extent of reserved forests at the end of the year was about 591 square miles, as against 593·14 in the previous year. The decrease is mainly due to the disafforestation of 2·14 square miles for food crop cultivation.

Selection and working of coupes.—The State forests continued to be worked principally on the contract system. In the case, however, of standing *elavu, cheeni* and other soft wood species, the seigniorage system was resorted to. Besides timber, firewood, bamboos and minor forest produce were removed or allowed to be so done as usual. The extraction of firewood was from areas specially set apart and it was done mainly on the system of coppice with standards.

Working Plan.—The preliminary working scheme sanctioned for the Orukomban working circle was adhered to as far as possible. The working plans sanctioned for the Medugal and Machad working circles could not be further carried out owing to the selection of areas for food crop cultivation. But such compartments as were not likely to be affected by the exclusion were treated according to the scheme laid down. Works in accordance with the plan of operations sanctioned for the year were fully carried out.

Communications.—The Tramway continued to be the prime means of forest transport. Carting and floating were the other means resorted to.

Forest Crimes.—There were 37 cases pending disposal at the beginning of the year and 87 new cases were reported. Of these, 57 were compounded, 16 dropped or otherwise disposed of, 18 convicted, 4 acquitted, and one entered in the block register leaving 28 cases for disposal at the close of the year.

Protection from fire.—Fire protection of the forests, as a whole, was not taken up, but specially protected areas were safe

guarded from fire. The Ayilmudi and Athanad blocks of Nemmara sub-division, the Medugal working circle, the Vadakkancheri and Puthur teak plantations and the sandalwood area in Kanjirakkode in the northern division, the worked coupes of the D series, the two teak plantations and depôts of the O. W. C. sub-division and the teak plantations of Chettikulam, Arattukadavu, Puilkanny, Kalkuzhi and Palapalli in the southern division were all fire-traced during the year.

Silviculture.—In places where improvement fellings were effected and light admitted on to the ground, natural regeneration, especially of deciduous species, was very satisfactory. An extent of 50 acres in Ammattikunnu, near Vadadakkancheri, Northern Division, and 919 acres in the Southern Division were taken up for planting during the year. Of the 191 acres in the Southern Division an extent of 121 acres was worked under the *taungya* system. An area of 15 acres in Puthur and of about 4 acres in Vettikad hills was also planted.

Coffee.—The total area under coffee cultivation during the year was 2,039 acres. All the areas cultivated, with the exception of 23 acres, were harvested. The total yield was 489 bushels of cherry dried coffee and 11,669 bushels of parchment. The number of persons permanently employed was 236 and the number of temporary hands 587. The demand under quit rent was Rs. 7,291, the whole of which was collected.

Rubber.—The extent of land under rubber cultivation was 13,008 acres. The rent on the lands amounted to Rs. 26,450.

Privilege to ryots.—The concessions allowed to the people by the rules framed under the Forest Regulation such as the grazing of cattle and the free removal in head loads of dry fuel, split bamboos, thorns, manure leaves and other produce useful for domestic and agricultural purposes were continued in the year.

Elephants.—There were 19 elephants in the department at the beginning of the year. Six captures were made under the pit system. Of these six, two were liberated from the pits owing to injuries sustained in the fall and one died as soon as it was kraaled. Five more died in the course of the year and two were sold. There were thus 15 elephant left at the end of the year. Five

new pits in the Southern Division and 13 in the Northern Division at a cost of Rs. 234 were dug in the year.

Gross yield and outturn.—1,724 candies of teak, 437 candies of rosewood, 104 candies of ebony, 4,598 candies of junglewood and 3,606 tons of fuel were removed from the forests by Sirkar agency, and 3,312 candies of teak, 208 candies of rosewood, 13,702 candies of junglewood and 15,100 cart-loads and 200 tons of fuel were removed by purchasers and consumers. Out of the Government collections in stock in the depôts 7,069 candies of teak, 401 candies of rosewood, 7,954 candies of junglewood, 99 candies of ebony and 3,606 tons of fuel were disposed of. The value of forest growth sold amounted to Rs. 56,820. The stock of felled and collected timber lying in the depôts at the end of the year was 8,691 candies composed of 4,430 candies of teak, 1,704 candies of rosewood, 14 candies of ebony and 2,543 candies of junglewood.

Financial.—The receipts and expenditure of the department for the year were Rs. 5,89,433 and Rs. 1,84,844 respectively, as against Rs. 4,65,099 and Rs. 1,86,069 in the previous year. The net result was a surplus of Rs. 4,04,589. The budget and revised estimates of receipts were Rs. 4,83,700 and Rs. 5,38,800 respectively as against Rs. 2,04,600 and Rs. 1,98,200, the corresponding amounts estimated for expenditure. Against this net surplus has to be set off Rs. 94,301, the net maintenance charges of the tramway.

THE "LONGOTRA" OF MADAGASCAR CLASSIFIED.

Last November the editor received for identification from Mr. Rudolph Block, New York City, a specimen of Madagascar wood known as "longotra mena." The presence of large oil cells, together with certain other anatomical features, clearly indicated Lauraceæ, but the wood differed from all known members of that family in having very distinct "ripple marks," all elements being storied. The matter was referred to Professor Henri Lecomte, the foremost authority on Madagascar woods who replied as follows (translation):

"We have had botanical and wood specimens of 'longotra fotsy' for the past five or six years, but the material was not sufficient for determination; in my notes it is recorded as doubtfully Lauraceæ. It was because of this doubt that I did not consider it advisable to mention the wood in my work, "Les bois de la foret d'Analamazaotra." Since then we have received another specimen of 'longotra fotsy' from Mr. Louvel and one of 'longotra mena' from Mr. Perrier de la Bathie. Upon receipt of your letter Mr. Paul Danguy and I examined these specimens and are convinced, beyond possible doubt, that they belong to the genus *Cryptocarya*. My assistant has described two new species, *C. Loiselii* P. Dang and *C. Perrieri* P. Dang., *respectively. Because of the opposite arrangement of their leaves*, these two species are easily distinguished from others of the genus, and the woods of India we have in our collections under the name of *Cryptocarya* do not have storied rays, whereas this feature is very distinct in the 'longotras' of Madagascar.

"In an article, which appeared in the *Bulletin Economique de Madagascar* in 1924, Mr. Louvel calls attention (p. 90) to the 'longotra mena' and further along reproduces a photograph of a 'longotra mena' tree having a basal circumference of 7·50 meters. This proves that it is a very large tree and, thanks to your query, we now know its exact classification."

Comparison of the wood in question with specimens of Cryptocarya in the Yale collections leads the editor to believe that the differences are of generic rank rather than specific only. At least they are sufficient to demarcate a sub-genus.—(*Tropical Woods, 1st March* 1928.)

GRANT OF PROTECTION TO THE PLYWOOD AND TEA CHEST INDUSTRY.

(Tariff Board Report and Government of India's Decisions.)

The following is a Resolution [No. 483-T. (4), dated the 18th February 1928] of the Government of India in the Department of Commerce:—

The Report of the Tariff Board regarding the grant of protection to the Plywood and Tea Chest Industry has been published.

2. The Government of India accept the findings of the Tariff Board—

(*a*) that the manufacture of plywood tea chests should be protected;

(*b*) that the protection required by the industry is 7 annas 9·6 pies per standard chest (excluding fittings and linings), and

(*c*) that the protection given should be continued for a period of five years.

3. The Board have recommended that protection should be given by means of an export duty on all tea packed in chests which are not made in India. The Government of India consider the proposed method would lead to undesirable complications and they are unable to approve the imposition of an export duty for protective purposes. At the same time they are of opinion that the Board attached undue weight to the objections to the grant of protection by means of an import duty. The additional burden imposed on the Tea Industry by the duty will not be a heavy one, and where protection is the object to be attained and not revenue, the refusal of a drawback on re-export is not in their view open to objection in principle. They have, therefore, decided to introduce legislation imposing a duty of 30 per cent. on all forms of plywood and on the battens and corner pieces of plywood chests, and abolishing the drawback at present admissible under the Sea Customs Act, 1878, on re-export. The 30 per cent. duty will in effect give the same amount of protection as was recommended by the Board. It is proposed for reasons of convenience in the Custom administration to apply it to all forms of plywood but the imports, other than tea chests, are very small and the Government agree with the Board that if they alone were in question no protection would be needed.

4. The subsidiary recommendations of the Tariff Board are under the consideration of the Government of India and will

where necessary, be brought to the notice of the Local Governments concerned.—(*The Indian Trade Journal*, 23*rd February* 1928).

HARDWOOD MARKET.

We are still unable to report any material improvement in the Hardwood market, business in general remaining somewhat quiet.

East India Teak.—Timber.—There has been rather more enquiry, and with rather limited unsold supplies in the East, values are firm. Planks and Conversions.—The demand remains small. Java logs and flitches are neglected. Quotations for ordinary specifications are: Timber £23 to £40 (Java, £17 10*s.* to £27); Flitches, £30 to £42 (Hewn Java, £18 to £30); Planks £24 to £40 (Java, £17 to £28); all at per load on c.i.f. terms.

The analysis of deliveries and stocks is as follows:—

	Deliveries during March. Loads.		Deliveries to 31st March. Loads.		Dock Stocks. Loads.	
	Timber.	Planks.	Timber.	Planks.	Timber	Plank.
1928 ...	140	194	248	865	1,869	3,929
1927 ...	256	238	898	555	2,490	2,760
1926 ...	215	381	965	958	2,340	2,338

Padouk.—There is only an occasional enquiry. Quotations are 6*s.* to 12*s.* 6*d.* per foot cube.

Satinwood.—East India.—There is no outlet for plain logs except possibly at bargain prices, but well flowered logs of satisfactory character command good prices. St. Domingo.—There is nothing fresh to report. Quotations are 9*d.* to 4*s.* per foot super for East India; 6*d.* to 1*s.* 6*d.* for St. Domingo; and nominally, £15 to £30 per ton for Porto Rico.

Rosewood.—East India.—Such enquiry as there is runs on strictly prime logs of large girth. Rio and Bahia—Are seldom enquired for. Quotations are: Rio, Bahia and East India, £10 to £34 per ton. Madagascar.—Stocks are sufficient for the present. Quotations are £4 to £10 per ton.

Ebony.—East India and Ceylon.—Shipments cannot be advised, as there is no request for either variety. West African and Madagascar.—The position remains without change. Mozambique (African Blackwood or Grenadillo)—Supplies on hand are sufficient for the present. Quotations are: East India, £10 to £20; Macassar, £8 to £15; Madagascar, £12 to £20; Gaboon, £16 to £30; Mozambique, £4 to £12, all at per ton.

(Extracted from C. Leary & Co's London Market Report, 1st to 31st March 1928.)

RESOURCES OF THE EMPIRE.

TIMBER EXHIBITION.

(Lord Lovat on Hardwood Products.)

The first exhibition of Empire timber in this country was opened yesterday, at the Imperial Institute, South Kensington. It is the second exhibition of a series arranged by the Institute to call attention to particular resources of the Empire, with the object of increasing the use of its raw materials. The opening was performed by Lord Lovat. He was introduced by Lieutenant-General Sir William Furse, Director of the Imperial Institute, and among those present was Mr. Ormsby-Gore, M.P., Under-Secretary to the Colonial Officer.

Lord Lovat said that the Imperial Institute had in the last couple of years been getting a real grip of matters of interest to the Empire. The temporary exhibitions, of which that was one, were a new line of development. Rubber was shown last year. This year timber had been chosen, and he doubted whether there was any product grown in the Empire which should be of more interest to those who concerned themselves about the Empire. The timber lands of the Empire were of enormous extent—about 1,200,000,000 acres. There was grave anxiety on the subject of the reserves of virgin softwood timber, and as time went on there would be more and more demand for substitutes, which would very often be found among the substitute hardwood timbers of the Empire.

It was necessary that people should know where these kinds of wood could be found, what were their uses, and cost, and other particulars about them; and he hoped that many of the consumers would come to see the exhibits. Valuable as was an exhibition of that kind at present, a similar exhibition a few years hence, after, say, the next Imperial Conference, at which he hoped an Imperial Bureau of Forestry would be started, would probably have still greater value. We required to know about our Imperial products, specially about hardwood products which came from the non-self-governing Colonies.

The exhibition has been arranged in the Exhibition Pavilion of the Institute, and has been designed to draw attention to the useful timbers grown in commercial quantities in the oversea parts of the Empire. Many such timbers, chiefly hardwoods, are little known outside the trade, and some have not yet been marketed in this country. The Institute has brought together samples of both the better known and less known kinds. Cards are fixed to them, giving brief descriptions, with particulars of their uses and cost. Those timbers which have been recommended in a list prepared by the Timbers Committee are marked with a red disc. Furniture, joinery, musical instruments, and motor bodies made from Empire timber are also shown, and much of the finer work reveals in a striking degree the beauty as well as the utility of many Empire woods.

Among noteworthy exhibits are doors in Indian timbers designed by Sir Herbert Baker for India House (Messrs. Holloway Brothers); a parquet flooring, in Australian silky oak (Messrs. Howard Brothers); a billiards table in Indian and Sapele mahogany (Messrs. Burroughes and Watts); the first examples of veneer cut in Australia and marketed in this country in Australian blackwood silky oak (Messrs. Anthony Gibbs and Sons); a quarter grand pianoforte in Australian walnut (Messrs. J. Broadwood and Sons, Limited); and an automatic gramophone in Indian laurel (the Gramophone Company). There are also exhibits provided by the Imperial Forestry Institute, Oxford, to illustrate the principles of silk culture, forest management, tree growth and diseases and pests of trees; and by the Forest Products Research

Laboratory, Princes Risborough, to illustrate aspects of timber utilization, timber mechanics, wood technology, and diseases and pests of timber. A joint exhibit of the two institutions deals with the structure and identification of wood.

The exhibition will remain open till April 30.—(*The Times.*)

PAPER FROM THE BAOBAB.

A TRANSVAAL EXPERIMENT.

Johannesburg, January 19th.

A paper pulp factory has been erected in the Baobab Tree region of Northern Transvaal and operations have begun. At the present stage the pulp is not being reduced to paper on the spot, but is being sent away. Thus far the Forest Department has marked off ten Government farms, which will be occupied by farmers holding a lease with the option of purchase. The moneys received by the Government for the trees will be credited to the lessees and go in reduction of the purchase price of the farms. The price of a tree varies from £5 to £7. For exceptionally big trees the price will run to over £20, but such specimens are rare. A certain proportion of the trees are being retained for scenic purposes and for propagation purposes. It is also stipulated that for every tree removed the lessee of a farm must plant 24 baobab seeds and a certain number of truncheons from the tree felled — (*The Times.*)

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A TIGER KILL.

There has been of late a certain amount of discussion as to the methods adopted by tigers when killing and only the other day a letter appeared in the "Field." The following facts might be of interest to readers of the "Indian Forester":—

It happened some years ago while camped with a class of Rangers at Lachiwala in the Dun (Dehra Dun). I had noticed that a tiger moved on the same road nightly and I tied for him three times, and three times he killed and never returned.

Owing to restrictions on shooting after sunset, there seemed very little chance of getting him, so I decided to 'tie-up' and watch him kill. I left camp at 8 P.M., and reached the place I had decided on by 9 P.M., in fact I was ready in position by that time, with a young buffalo as bait. There was the usual wait, listening to the various noises of the jungle. At 10-45 the cheetal and sambhur became restive,—one sambhur galloped past me,—and I felt certain 'something' was on the move; sure enough the tiger appeared about 60 yards down the road in front of me. It was a beautiful moonlight night and I was seated in the fork of a tree which stood at the junction of four cross-roads. He slouched down the road towards the buffalo, who now terror-stricken, stood absolutely still. One noticeable feature was the unconcern of the tiger; he just came steadily on. I am sure he realized that the animal was tied; he had killed so many before.

At 10 yards he crouched like a cat stalking a bird, and advanced on his belly. Then the most amazing thing happened; the buffalo who up to the moment was stricken with fear suddenly came to life and made a desperate charge (I had tied him with a long rope on the near hind leg). The tiger taken by surprise was literally hurled into the jungle. The buffalo, now ready for the fray, looked on all sides for the next point of attack. Again the tiger approached in the same manner, and again the buffalo defended its life with a charge, and with the same results. This happened three times, and I was jumping about to get the best view, and I suppose making a certain amount of noise; as the tiger came for the fourth time he stopped and looked at me, and was not a bit alarmed. This time he approached more stealthily; they were almost nose to nose and the wretched buffalo, exhausted and afraid, was too late; out shot the left paw of the tiger and caught the buffalo on the side of the head; over he rolled and in a flash the tiger seized him by the throat, jumping round behind and across the back of the buffalo to do so. There was a twist and a turn, and he appeared to break the animal's neck, because it never moved again. The tiger retained the grip on the throat for what appeared to be 15 minutes—he was breathing deeply and sucking the blood. During the whole time of the attack hardly a sound was made except the shuffling of the feet. The 'valiant' little buffalo gave his life fighting all he knew, and the tiger got his meal in his usual way. Then came the dragging; I could almost feel the deep hot gurgling breath of the animal as he practically lifted his kill by the throat, with the carcass round his left shoulder; he was exerting all his strength and resting every few yards. His one thought now was to get his meal in seclusion, away from prying eyes and hungry mouths. I saw him actually lift his prey up an almost vertical bank of six feet, but it was a mighty effort.

At dawn I followed up the drag and found the carcass half eaten. I sat up in the evening, the tiger came but was disturbed by coolies drawing water. The tiger was shot a month later.

C. T. TRIGG, I.F.S.

SOME EFFECTS OF FROST ON SAL IN THE UNITED PROVINCES.

In the "Indian Forester" for October 1923 I contributed a short article on frost as a cause of unsoundness in sal. The article was the result of an investigation carried out in two localities where the 1905 frost had done much damage to a sapling crop One locality was Gola Tappar in the Dehra Dun, the other was Sitabani in the outer low hills of the Ramnagar division. In both cases the frosts were of the type which I distinguished in a further article in this journal for December, 1926, as "hill frosts." Briefly, my investigations which were subsequently corroborated in all essential points by Mr. Hopkins (*vide* his article in the "Indian Forester" for May 1924) showed that:—

(1) about 40 per cent * of affected stems produce at least two well-developed leaders,

(2) stems which have been cut back by the 1905 frost are invariably unsound,

(3) this unsoundness extends down the stem at an average rate of 6 inches a year.

(4) about 50 per cent. of the trees show signs of a more or less occluded channel down one face, the visible portion of this scar averaging 2·5 feet in length.

Commenting on this last phenomenon I remarked that it was apparently due to the cambium dying on one side of the stem to a lower point than on the other. I added that unfortunately no observations had been made to determine whether the position of the scar is correlated with the points of the compass and that had this been done it might have been possible to explain the phenomenon on a scientific basis. When Mr. Hopkins carried out his observations in order to test the accuracy of my results he attempted to follow up my idea as expressed above and to quote his own words "It was found, however, that the aspects of these scars were exceedingly variable, and in one especially noticeable case the scars of three trees all growing close together were fac-

* Mr. Hopkins found only 20%, but apart from local variations I suggest this might have been due to thinnings in which a larger proportion of forked stems are usually removed.

ing in three different directions. It seems, therefore, that the position of the scar has nothing to do with the aspect."

The probable frequency of such abnormal cold years as 1905 is another point on which I touched in my original article, but I failed to discover any data of value to help in forming a decision, though I was able to quote Colonel Pearson's remark written in June 1905 in which he states that during his Indian experience he recollected two instances of excessive cold in the Central Provinces, one in January 1860 and the other in March 1864.

A subsequent article of mine in the "Indian Forester" for August 1927 dealt with a somewhat different aspect of frost, namely, the necessity or otherwise for maintaining a protection overwood where sal regeneration is concerned. I shall not again refer to this particular aspect of the general frost problem and before entirely leaving the subject, I should like to remark that Mr. J. R. Singh's observations on the frost damage resulting to sal in the Dun during 1926-27 seem to entirely corroborate my own conclusion as to the futility of reserving scattered standards in the hope of preventing the sal shoots beneath from being damaged by frost. This is a problem which has been included in the United Provinces five-yearly research programme as a subject for experimental investigation, but I maintain that anyone walking through a forest situated in an area liable to severe hill frosts has the experiment already performed by nature open to his inspection, and no further proof is required.

The above is, I believe, a correct summary of the present literature on the subject, and when I commenced a tour this year in the Saharanpur and Dehra Dun divisions, both subject to severe frosts, I decided to try and solve some of the remaining problems. More especially I desired to discover :—

(1) the previous occurrences of severe frosts,

(2) the origin of the frost scar produced by the 1905 frost,

(3) The possible effect of frost on timber production.

My first step was to act on the observation made in 1923 to the effect that 40 per cent. of sal cut back by the 1905 frost

produced two strong leaders, causing an obvious bifurcation of the stem. I, accordingly, set about to look for trees the stems of which showed similar bifurcations produced by earlier frosts. I very soon found that in the Dehra Dun forests such trees were by no means rare and I examined carefully 50 trees growing at Phandowala, Kansrau and Motichur with the following result :--

	G A	A B	G B	B D	G D
Average length in feet	27 7	25	45	17·2	16·5
Number of trees on which the average is based.	21	19	48	48	50

Where G D is the distance from the ground to the point to which the stem was cut back in 1905.

Where G B is the distance in a frost previous to 1905.

Where G A is the distance in a frost previous to the B frost.

In collecting these data no fork under 15 feet from the ground level was taken into consideration. This was a necessary precaution in order to rule out as far as possible other causes of damage than frost. It may also be noted that all trees showing the A frost were over 20″ diameter at breast height, and the greater number were over 24″ diameter. Those showing the B frost were all over 12″ diameter and the majority were over 15″. It will be observed that I have jumped from B frost to D frost. This is because in the course of collecting the above figures I discovered the presence of an additional, hitherto unsuspected, frost between B and D. I subsequently fixed the position of the C frost from measurements of 28 sapling and pole stems showing clearly both C and D frosts in the Lambirau block below Thano. From these observations C D = 2·7 feet and varies from 1 to 6 feet.

All the above figures, excluding diameters, were based on careful eye estimates.

I have also examined a number of old annual reports of the

Dehra Dun division and the following facts therein contained bear directly on the matter under consideration :—

1890-91 report.—Reproduction suffered severely from the long and cold weather in 1891 (up to March). On two occasions 9° of frost were registered in Dehra*. All sal leaves killed in low-lying forests even on big trees up to 60 ft. high.

1899-1900 report. Very severe frosts which did much damage to saplings, especially on the lowest slopes of the western Dun.

The minimum shade temperatures recorded at Dehra Dun are also available from 1868 onwards. They vary up to 40·1°F. but only three years showed minima below 34°F. and these, together with the minima for 1891 and 1900, are given below :—

January 1874 ...	...	..	31·8
February 1876 ...	...	...	33·9
February 1891 ...	...	...	35·4
January 1900 ...	...	...	37·8
February 1905 ...	...	...	30·1

If these records be considered in conjunction with the information obtained from annual reports it is evident that whereas an abnormally low temperature record at Dehra Dun would mean that a severe frost had occurred throughout the Dun, yet the converse is not true—namely, that a severe frost in the Dun will necessarily mean that the minimum temperature recorded at Dehra Dun will be abnormally low. This is easily explained by the theory which I have put forward in previous articles that such hill frosts are limited in their extent to a definite level above and below which great differences of temperature may be simultaneously recorded.

Observations were also necessary to determine the rate of growth of leading shoots in the case of vigorous saplings or poles after they had been cut back by frost. For this purpose 20

* Minimum temperatures recorded at Dehra by the Survey department are shade temperatures and probably this record was not a shade temperature.

vigorous stems were felled in Lakarkot 1 and 2 of the Saharanpur division and these showed that—

A leading shoot 1" diameter at base is 3' 7" long.
" " " 2" " " " " 7' 8" long.
" " " 3" " " " " 13' 8" long.

I already knew from measurements of 55 trees made in 1923 in Gola Tappar and Sitabani that during the 18 years since 1905 the average length of shoot formed was 32 feet which is equivalent to 1·8 feet per annum.

With this information it is now possible to calculate the year in which the successive frosts occurred. One assumption only is necessary. This refers to the length of shoot which was cut back by each successive frost. My examination of damaged stems in 1923 led me to conclude that the shoots had been cut back in 1905 to a point where the stem was about 2" diameter, and this has been found, as already indicated, to correspond to a shoot about 7 feet long. This figure agrees with the fact that the D frost of 1905 cut back the majority of stems to a point 3 feet above the point to which they were cut back by C frost; because if (as will be shown later) the C frost occurred in 1900 then, during the five years from 1900 to 1905, the shoot would attain $5 \times 1.8 = 9$ feet length with a basal diameter of about $2\frac{1}{4}$ inches.

As regards frosts in the years B and C it is certain that the C frost was comparatively slight and the same is probably true of the B frost since neither of these caused any abnormally low temperature at Dehra Dun. My observations in the forest, however, lead me to conclude that the B frost was moderately severe in spite of the Dehra records. I have, therefore, assumed that the length of shoot cut back by the C frost was 2 feet and by the B frost 5 feet.

On these assumptions the leading shoot had grown as follows between the years A and D, *i.e.*—

25 feet from A to B.
5 feet above the point where it was cut back at B.
14 feet from B to C.
2 feet above the point where it was cut back at C.
3 feet from C to D.

7 feet above the point where it was cut back by the 1905 frost.

Total 56 feet.

The rate of growth of the leading shoot being 1·8 feet per annum, the length of time taken to produce a shoot 56 feet long $= \frac{56}{1 \cdot 8} = 31$ years.

Therefore the A frost occurred in the year 1874 (1905—31). Similarly, between the years B and D the shoot had grown 26 feet, and the length of time taken to produce this shoot $= \frac{26}{1 \cdot 8} = 14$ years.

Therefore the B frost occurred in the year 1891 (1905—14).

Again, between the years C and D the shoot had grown 10 feet and the length of time taken to produce this shoot $= \frac{10}{1 \cdot 8} = 6$ years.

Therefore the C frost occurred in the year 1899 (1905—6). Information regarding frost years may now be tabulated for comparison as follows:—

According to calculations based on rate of growth.	According to records of temperatures kept at Dehra Dun.	According to records given in annual reports.
1874	1874 (and probably 1876 in a minor degree).	No records.
1891	No abnormally low temperature recorded.	1891.
1899	Ditto ...	1900.
......	1905	1905.

The agreement here is so uniform that it is impossible to doubt the accuracy of the assumptions made, and it may be safely concluded that the damage visible in the Dun forests is mainly due to the frosts of 1874, 1891, 1900 and 1905.

A sal tree in which the effects of the 1874 and 1891 frosts are clearly visible.

A sal tree showing clearly where it was cut back by the 1900 and 1905 frosts.

Outside the Dun I have only made measurements similar to the above in one small area in the Haldwani division. In the absence of further statistical proof there is an abundance of ocular evidence to show that the same four frost years affected all the forests of the sub-Himalayan tract liable to frost at least as far west as the Sarda river. From what I have lately seen in the Haldwani division I think the 1900 and 1905 frosts were less severe there than further west, but the effects of these two frosts combined with well-marked frost scars are well shown in compartment 1 of Bhandarpani block in the Ramnagar division, whilst good examples of forests showing the 1891 frost damage are the Sela block in Haldwani division and the Lachampur and Palkot blocks in Ramnagar division.

It will perhaps assist anyone wishing to recognise these frosts at a glance if I say that the shoots produced by the 1905 frosts are now usually 4 to 6 inches diameter and the bark of these shoots still retains the rather smoother appearance of young healthy bark. The two stems above the point to which the stem was cut back in 1891 are usually 6 to 10 inches diameter, and above the 1874 bifurcation 10 to 14 inches diameter. If you examine those stems which produced a single leader after being cut back, you find the 1905 and 1900 frosts are usually still quite obvious, but the point where the stem was cut back in 1891 is more or less obscured and the result of the 1874 frost is, I think, unrecognisable.

In Plate 21 will be seen a sal 7′ 3″ girth at breast height which bifurcates 20′ from the ground, indicating where it was cut back by the 1874 frost. Each bifurcation again forks another 35′ above this point, showing where the two leaders were cut back by the 1891 frost. The effects of the 1905 frost are scarcely visible in the photograph though easily recognised in the crown of the living tree another 20 to 30 feet above the forks produced by the 1891 frost. This photograph was taken in Phandowala block compartment 9 at 1,800′ elevation.

Plate 22 shows a sal tree cut back first by the 1900 and then by the 1905 frost. Each frost produced a fork, one about 2½ feet

above the other. This photograph was taken in the Kaluwal block at 1,700′ elevation.

I will now give the results of my enquiry into the origin of the frost scar produced by the 1905 frost. My investigation was confined to recording with the help of a pocket compass the direction in which the scar faced. For this purpose I first selected three areas in the Dehra Dun and for the sake of convenience I shall call them A, B and C, (*vide* accompanying sketch map, Plate 23). It is necessary to give very briefly the following description of these areas :—

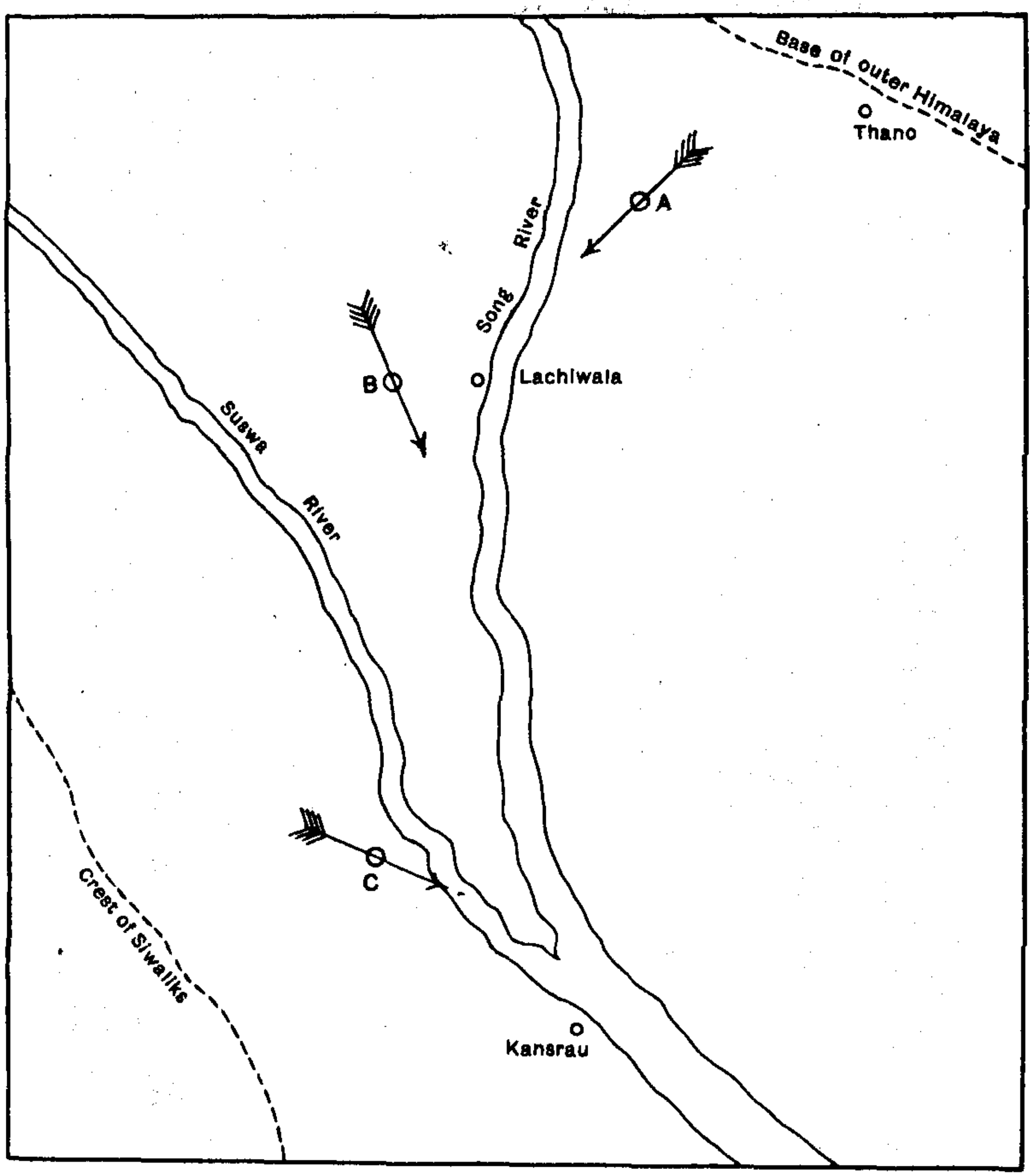
A.—Compartments 35 and 36. Lambirau Block. Elevation 1,900′. Ground gently sloping southwards and cut up here and there by ravines. Frost scar up to 10′ long and often open and deep.

B.—Compartment 6. Lachiwala Block. Elevation 1,800′. Ground with a very gentle slope southwards, not cut up by ravines. Frost scars up to 6′ long ; not quite so bad as in "A".

C.—Compartments 1 and 2, Bahera Block. Elevation 1,500′ to 1,600′. Ground with a gentle E. N. E. slope intersected by a few shallow ravines. The frost scar was generally much less severe than in either "A" or "B".

The results of observations are tabulated below :—

Direction in which the scar faced.	Number of trees.		
	A	B	C
W. S. W.	...	...	5
W.	...	...	11
W. N. W.	...	1	29
N. W.	1	6	9
N. N. W.	1	26	7
N.	8	21	4
N. N. E.	20	14	3
N. E.	17	2	2
E. N. E.	20	...	...
E.	3	...	...



Sketch map showing direction of cold winds

Scale—½" = 1 Mile.

N§127. 906.

The figures underlined indicate the prevailing direction in each area and it is scarcely necessary to point out the striking consistency with which the figures group themselves. The variation in the prevailing direction in the three areas is, I believe, explained on the theory that the scar is produced by a cold wind, the prevailing direction of which varies according to the configuration of the ground and the general position of the locality with reference to the surrounding hills, but remains approximately constant in one and the same locality. For instance, let us examine the three areas in which I made observations. In area "A" the slope of the ground is south and in the absence of other local factors the wind would probably blow from the north. However, an examination of the ground shows that the Song river passes a mile or so distant to the south-west. This river flows in a southerly direction, and the strong flow of air which would take place down the bed of the stream at night would certainly tend to draw in air from all sides. This indraught should suffice to change a northerly wind, in the area where my observations were made, to a north-easterly wind—thus accounting for the scars facing N. E.

In area "B" the slope is again south and the Song river passes about 1½ miles to the east. The indraught caused by this big river has apparently changed a wind which would normally be north to one which is N.N.W.—thus accounting for the scars being N.N.W.

The slope in area "C" is E.N.E., being situated on the lower slopes of the Siwalik range. But the Suswa river flows along the N. E. boundary of this area in a south-easterly direction. The slope, considered alone, would indicate a W.S.W. wind, but the influence of the Suswa has evidently converted this into a W.N.W. wind and it is in this direction that the maximum frost scar is found.

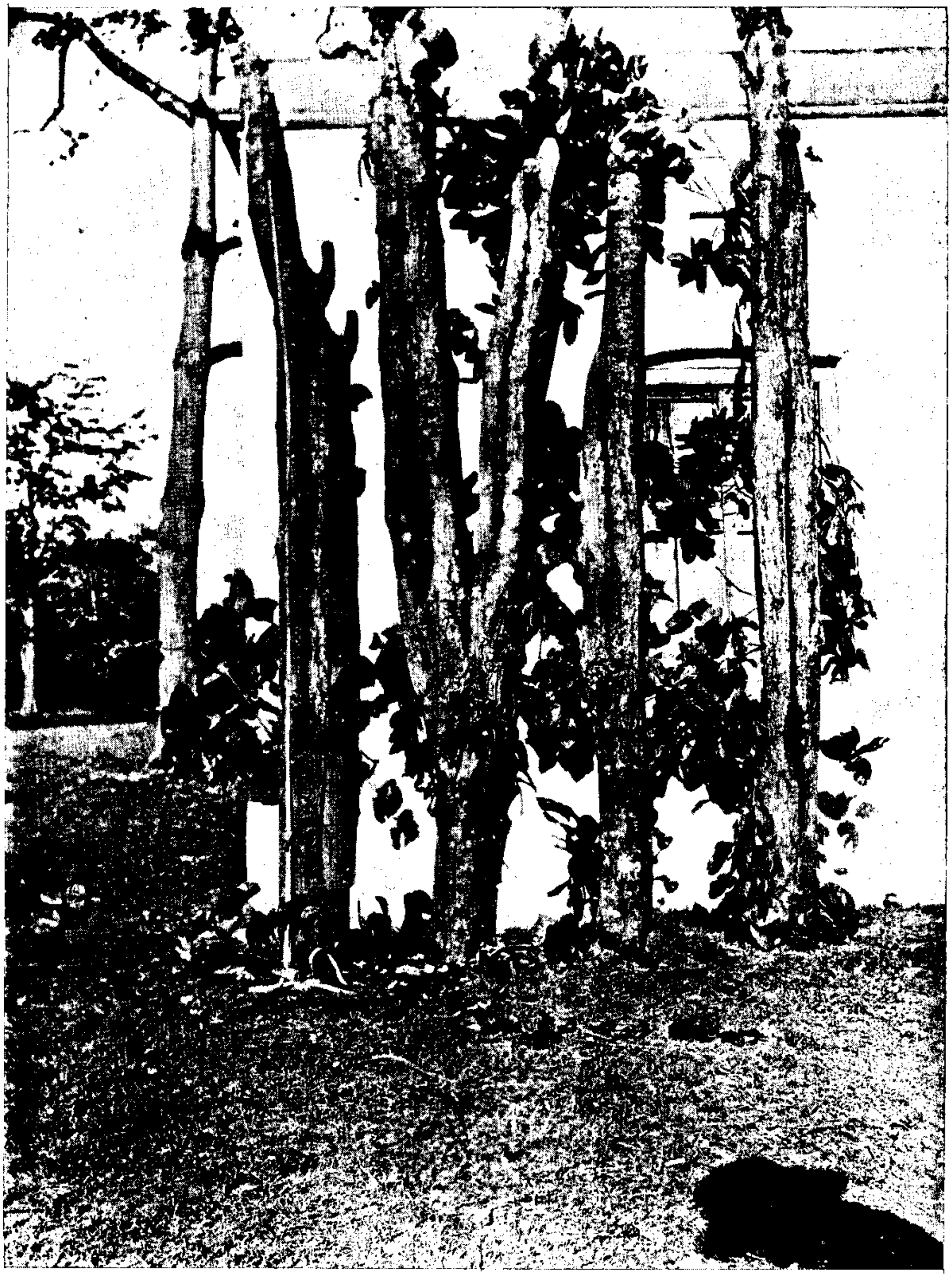
The above explanation, which is also confirmed by more recent observations at Sitabani, seems to me to meet the facts of the case and I have no hesitation in saying that the frost scars have been produced by a very cold wind which so reduces the temperature of the stem on the windward side that a considerable portion

of the cambium is killed on that side. Callus then commences to form beneath the outer dead bark but, except when the damage is slight, this falls off before the wound is occluded, and in very severe cases or where the vitality of the tree is impaired (as in suppressed trees) the wound remains open. I have refrained from using the term "frost crack" in this connection, because I do not think that a sudden rent is produced by the cold in either the wood or bark. Most of the stems with noticeable frost scars in area "C" (where frost damage was less severe) were suppressed stems under a more or less complete overhead canopy. I think this is explained by the impaired vigour of such stems thus preventing the wound from being rapidly healed and concealed from view. It is, however, noteworthy that these suppressed stems were at least as much affected by the frost as those unprotected by overhead cover; a fact which corroborates my view that a light shelterwood of standards will not have the desired effect of protecting the young growth beneath from frost.

I must also remark on the fact that these scars usually, if not always, occupy the whole space between the points to which the stem has been cut back by the 1900 and 1905 frosts respectively. Typical examples of scars are shown in the accompanying Plate 24. It will be noticed that one of the stems forks were cut back by the 1900 frost.

I will now pass on to a consideration of the third and last problem which I set myself to investigate, namely the possible effect of frost on timber production.

Such information as I have been able to collect is derived from two sample plots in the Saharanpur division and two in the Dehra Dun division. I will take the former first. They are both ancient sample plots in which measurements were made consecutively from 1882 to 1916. I have carefully examined the registers containing the measurements and in my opinion the records show evidence of having been maintained with great care and accuracy and I consider the results, when averaged for a number of stems over a 10 year period, trustworthy. The records were



Sal stems showing vertical scars, the result of the 1905 frost.

inscribed in three registers. That for the period 1904—1916 has now unfortunately been lost, so I was forced to accept, without check, the figures given on pages 50 to 52 of the working plan. The figures for the other two periods have been carefully recalculated from the registers.

The following table gives the periodic mean annual diameter increments in inches of the two sample plots for 2" diameter classes compared with those for the three quality classes as defined by Howard :—

Diameter at breast height (inches).	Lakarkot 1.			Dholkhand 1.			Quality I.	Quality II.	Quality III.
	1904—16.	1892—1903.	1882—1892.	1904—16.	1892—1903.	1882—1892.			
4 ...	·03	·09	·10	·05	·09	·12	·30	·22	·21
6 ...	·05	·10	·14	·06	·10	·16	·29	·22	·21
8 ...	·06	·11	·17	·09	·11	·17	·26	·22	·18
10 ...	·06	·11	·18	·10	·12	·18	·22	·20	·15
12 ...	·06	·12	·18	·11	·12	·18	·21	·16	·13

In drawing conclusions from these figures I shall reject those for the lowest two diameter classes because I have good reason to believe that they were partly composed of suppressed trees. With this proviso I reason as follows :—

(*a*) The 1904—16 period showed the lowest rate of growth of any of the three. This would certainly be due to the 1905 frost.

(*b*) Frost appears to have affected the Lakarkot plot more than the Dholkhand plot. The former being situated at a slightly lower level, where frosts are more severe ; the difference is easily understood.

(*c*) The 1892—1903 period does not show normal growth because of the 1891 frost.

(*d*) The 1882—1892 period shows growth nearest to normal for the quality of the locality because there had been no severe frost since 1874.

(*e*) The rate of diameter increment increases as the size of the tree increases, which is exactly opposite to what happens in a normal forest. This might be because the younger the tree the more severely is it affected by frost, or it might be due to the inclusion of a few suppressed trees even in the 8 and 10 inch diameter classes. I think both factors have influenced the growth.

In order now to assess the effect of frost as an agent in destroying the normal relation between the average height of the crop and diameter increment, a number of heights of trees were measured in both plots. These fell between 70 and 80 feet, placing the quality of the forest as low III quality. But the quality of these plots based on diameter increment, after excluding the lower diameter classes, would indicate—

Good	III	quality	for the	period		1882—1892.
Very low	III	,,	,,	,,	,,	1892—1903.
Below	III	,,	,,	,,	,,	1904—1916.

It is reasonable, therefore, to conclude from this comparison that the successive frosts of 1891 and 1905, coupled probably with other minor frosts, have had a marked effect in reducing the diameter increment; with a result that height no longer bears a normal relation to diameter increment, and if the former represents the quality of locality the latter does not. In other words the quality class deduced from figures of diameter increment will always be lower than the quality class deduced from a consideration of the average height of the crop, provided observation covers a sufficiently lengthy period.

I now come to a consideration of the two sample plots in the Dehra Dun division. These are numbers 11 and 15, the only two for which sufficient information is at present available. Sample plot 11 is situated not far from Thano, and sample plot 15 close to Gola Tappar; both in the eastern Dun. Unfortunately both these plots, but especially the former, have been subject to an attack of *Hoplocerambyx* which may quite possibly have affected the growth of the crop.

The following table shows the periodic mean annual diameter increments of the plots in inches, as for the Saharanpur plots:—

Diameter at breast height (inches).	SAMPLE PLOT NO. 11 1913—23.		SAMPLE PLOT NO. 15 1914—23.		Quality I.	Quality II.	Quality III.
	Dominant and dominated stems	Dominant stems only.	Dominant and dominated stems.	Dominant stems only.			
6	...	...	·10	·11	·29	·22	·21
10	·18	·18	·12	·12	·22	·20	·15
14	·17	·18	..	...	·20	·14	·11
18	·20	·20	...	...	·16	·12	...

One conclusion to be drawn directly from these figures seems to be that the effect of frost has been to reverse the comparative rate of diameter increment as between successive diameter classes. As remarked for the Saharanpur plots, this is easily explained by the younger trees being more affected by frost than the older. To explain the altered relation as being due to suppression is scarcely possible here, since the figures for dominant trees give the same relation as when dominated trees are included. It will, I think, be necessary to examine carefully many more plots before a final explanation can be given with any certainty.

Using the figures given above the following relation exists between the quality based on the average height of the crop and that based on diameter increment:—

	Sample plot 11.	Sample plot 15.
Based on height ...	Good quality II ...	Good quality II ...
Based on diameter increment.	Do. ...	Low quality III ...

From which it appears that whereas the older plot has not recorded any disturbing influence of frost on diameter increment

yet, in the case of the younger plot, it has had a marked effect. If it be conceded that frost has such an influence at all, it is easy to see that the effect of the 1905 frost (the last severe one) would be much greater in the case of the young plot. A remark made by the officer who laid out this sapling plot is so much to the point that I repeat it "crop chiefly top damaged by frost, but recovering by sending up new shoots."

As both plots 11 and 15 are recorded as being practically fully stocked I have also worked out the quality class for each plot based solely on the volume per acre of stem timber in the main crop after thinning. A comparison of the quality of locality figures thus obtained with those derived from a consideration of the mean crop height shows:—

(*a*) For sample plot 11, the quality based on height is ·75 of a quality class above that based on the volume of stem timber per acre.

(*b*) For sample plot 15, the quality based on height is ·55 of a quality class above that based on the volume of stem timber per acre.

Since the density of these plots is fairly complete I can only explain this result, as in the case of the Saharanpur plots, by assuming that the action of frost has altered the normal relation between height and diameter increment.

In conclusion, my observations on sample plots in these two divisions indicate very strongly that:—

(*i*) each severe frost has a marked effect in reducing diameter increment for an unknown number of years following the frost,

(*ii*) there is a tendency for the rate of diameter increment to increase in proportion as the diameter class increases, a reversal of what occurs in a normal forest,

(*iii*) the normal relation between the average height of the crop and diameter increment (or volume of stem timber per acre) is destroyed.

Should further investigations show these deductions to be correct they may have a far-reaching effect on our sal statistical work. It may, for instance, be found that sal crops liable to severe periodic frosts show such abnormal features of growth that they must be excluded from the normal yield tables and furnished with a separate yield table of their own. To what extent such a decision would affect Howard's existing sal tables I am unable to say as I am not aware which, if any, of the Dehra Dun plots have been utilised in compiling the tables.

Fortunately the Dehra Dun plots are due for remeasurement next season and as there are a large number of them it should soon be possible to test the truth of my theories.

Before concluding this article I wish to briefly discuss the relation between frost and epidemic attacks of *Hoplocerambyx.* On page 10 of Indian Forest Records, Vol. XI, Part VIII, Dr. C. F. C. Beeson and Mr. N. C. Chatterjee dismiss the possibility of frost damage as a cause of the outbreak in Thano with the following words :—"The compartments most seriously attacked by the borer were those that suffered least from the frost of 1905 ". It has occurred to me that possibly the authors might wish to modify their view when it is fully realised that the Thano forests have been subjected not only to the 1905 frost but to a succession of other frosts from their youth upwards. The oldest trees were much affected by the 1874 frost, as I have seen for myself. Moreover though I hesitate to contradict the statement quoted above, I cannot help thinking that the authors did not perhaps realise how widespread the 1905 frost was; there must be very little of the Thano forest which escaped serious injury. I notice too that in expressing the fallacy of the general idea that an epidemic attack is confined mainly to sickly or overmature trees, the authors have assumed that young stems are sounder than old stems and that unsoundness is largely synonymous with overmaturity. But, when dealing with areas liable to severe frost damage, the younger stems are probably quite as unsound as the older. In fact, at the present moment, the younger stems would probably show a good deal higher percentage of unsoundness than the older stems, owing to the 1905 frost. I have no expert knowledge of *Hoplocerambyx*,

but I ask those who have this knowledge whether the facts about frost brought out in this article are not sufficient to place frost as one of the contributary causes of epidemic outbreaks in such places as Thano.

The following is a summary of the main conclusions set forth above:—

(1) The frost damage visible in the forests of Dehra Dun division is mainly due to frosts in the years 1874, 1891, 1900 and 1905.

(2) Frost scars produced by the 1905 frost normally occupy the whole region between the points to which the stem has been cut back by the 1900 and 1905 frosts respectively.

(3) Frost scars have been produced as the result of a very cold wind which so reduces the temperature of the stem on the windward side that a considerable portion of the cambium is killed. In time the dead bark falls off, and in severe cases an open wound is exposed beneath.

(4) A severe frost has a marked effect in reducing timber production for an unknown number of years immediately following the frost.

(5) In areas subject to periodic severe frosts the normal relation between the average height of the crop and diameter increment (or volume stem timber per acre) is probably destroyed.

(6) Should further investigations show these latter deductions to be correct they may have a far-reaching effect on our sal statistical work.

In conclusion I wish to acknowledge gratefully the assistance given me by Mr. E. C. Mobbs who kindly worked out figures for the Saharanpur plots and also supplied some of the other information included in this article. I am also indebted to the Survey of India at Dehra Dun for permission to examine their temperature records.

A. E. OSMASTON, I.F.S.

DESTRUCTION OF FORESTS IN CHOTA NAGPUR IN BIHAR AND ORISSA.

If such data as is now available can be relied on, the greater part of Chota Nagpur was within the memory of man covered with valuable sal forests. The destruction of these forests to a certain extent was affected by the nomadic tribes, which moving from pasture to pasture, fired alike hills and plains wherever they went. With the advent of civilisation, the process of extending cultivation at the expense of the valuable existing forests was carried on for many years without any enquiry as to the ultimate effects. To this was added an increasing demand for timber for the construction of railways etc., and the increasing demand for pasture for rapidly multiplying herds of cattle; unrestricted felling, shifting cultivation and fire did the rest.

2. In a tropical country like this, apart from the climatic changes that it produces, the vital factor for the community at large is the determination of how far the denudation of these forests affects irrigation, local water supply and precipitation, erosion and sudden floods. In Chota Nagpur where the rocks are mostly friable the greater portion of the rain fall is lost to the local cultivators as it is rapidly carried away through sandy river beds. The most disastrous effect of denudation is generally not confined to the area where the forest is situated, for example, denudation of the catchment areas in the Hazaribagh district is responsible for serious floods in the plains in the Damodar valley. The origin of the almost annual floods in Orissa—rendering thousands of people homeless and converting the best of lands into barren wastes—can also be traced to the destruction of forests on the hills and plateaux of Chota Nagpur.

3. A classical example of what the denudation of friable hills can do, is that of the well known Hoshiarpur chos of the Punjab, where arable lands of 940 once prosperous villages were covered with sand, which laid waste upwards of 70,000 acres of fertile soil. History has since shown that the wholesale destruction of forests in Spain, Italy, Sicily, Greece and Macedonia has resulted in a great deterioration of climate over considerable tracts,

due to loss of moisture, sterilisation of soil, and excessive erosion.

4. Although in a special enquiry conducted by the Government of India during the years 1907—14 it was definitely established that denudation is an inevitable sequence of the clearance of forests it has not yet been possible for the Local Government to define and pursue any clear-cut policy, which will afford protection to the forests of Chota Nagpur. The difficulties are many, most of the forest areas are owned by private estates, innumerable prescriptive rights exist in the forest areas, and many members of the legislature are landlords who are naturally hostile to any form of State intervention in their estates. Of late there have been signs of awakening amongst private owners to the need of affording protection to their forests; a few of them have already taken advantage of Government offers (free of cost) of advice and help from the Forest department, but not enough to give a sufficient safeguard against future destruction. The wasteful methods of destroying forests in Chota Nagpur can be compared with the unrestricted lumbering in the United States of America. What is required before any sufficient protection to the remaining forest areas can be thought of, is regular forestry propaganda in order to cultivate a forestry "sense" in the people.

B. P. BASU, I.F.S.

[What would be far better would be a law requiring owners of private forests of more than a certain acreage to employ a professionally trained forest officer and to manage their forests under working plans sanctioned by Government. This is the law in most of the countries of Central Europe.—ED.]

THE LAC MARKET IN ASSAM.

Before coming to details as to how the market is controlled, I shall give a brief sketch of the mode of cultivation, describe the people involved in this trade, and the population exploited or benefitted. Among the several hill tribes who grow lac, the Mikirs of Nowgong district are the best growers, and no less than half of the lac exported from Assam is produced by them

The chief host plants are *Cajanus indicus* (*arhar*) and *Grewia multiflora* (*Kukursuta*); of these the former is sown along with the field crop and the latter comes up naturally as one of the prominent pioneer plants on *jhumed* land. At the time of weeding *Grewia* seedlings are taken special care of and are so spaced that when grown into saplings they look very much like a plantation. The shining leaves, smooth boles, conical crown and lac laden branches interspersed with wooly incrustations, are a familiar sight in these hills. The plantations are protected from fire and only condemned when the succulent branches become unfit to entertain lac insects. Pruning is occasionally done to prolong the trees' life. *Cajanus* does not live for more than two years. Of the two chief enemies fire and drought the former is preventible, but the latter factor which determines the year's crop, is at times most detrimental and the hill tribes, inspite of all their worshipping of the rain deities, from time to time suffer great loss.

(2) The first thing to be ascertained is whether and how far the growers of lac are denied their proper dues, as on this depends the future of cultivation. The cultivation is not worth the trouble and cannot flourish if the price of seedlac falls below Rs. 40 per maund at the buying centres, situated mostly at the foot of the hills where the growers bring their lac and sell it to the middlemen. Most of the hill people who grow lac are extremely poor and to many this is their only source of livelihood. It is, therefore, necessary that their interest should be safeguarded, as it has often been reported that these middlemen do not pay the proper price they should.

Marwaries and "Mirzapuri" merchants who export lac from Assam are really the link between Calcutta and the Assam market, and the rate announced by them serves as the guide for selling and buying at these centres. The competition amongst these middlemen is so keen that lac is often bought at the same rate at which the contract is made. It is also inconceivable that any combination could exist among them, as they are each openly out to do the other. But it cannot be denied that foul play has taken place in the past; as for instance during last December and January when "Commercial India" reported

that the Calcutta market for seedlac was Rs. 89 to Rs. 92 per maund, whereas the buying rates at these centres were from Rs. 60 to Rs. 62. Allowing for drying, cost of transportation, railway freight, royalty, storage, etc, the rate should have been Rs. 70. It might be asked, if the margin of profit is to disappear where lies the charm of the business. The charm really lies in the uncertainty of the market, and it is the ups and downs of the price that bring fortune and ruin to the series of middlemen, commencing from the buyers to the shippers, who have all to depend on luck, once having made a "Forward Contract." From the country buyers to the terminal sellers every middleman, through whom the lac changes hands sells for delivery at a future date, anticipating a fall in the price, so that he may buy at an advantage. This really is the attraction.

(3) These middlemen are necessities, and they do not upset the market, the real cause of the fluctuation of price is due to the sudden rise and fall of the foreign demand, aggravated by the speculators' intervention, which makes the thing an entirely ununderstandable affair and this is why the lac trade has often been called a subterranean business, not guided by the ordinary laws of economics. In these scuffles, the middlemen run the risk, the growers, however, usually get a fair price, whatever the Calcutta market rate. It is also true that speculators are now and then severely punished. During last December "Bears" were caught at the close to the extent of several thousand maunds, but the shippers did not penalise them in full as it suited the majority to be lenient. Messrs. Moran and Co.'s report, dated the 1st February 1928, given below, will give a glimpse into the Shellac and Seedlac market. "The past fortnight has seen violent fluctuations in the Shellac market. News of timely rain in the lac-growing districts together with large bear operations caused something like a panic and prices declined rapidly with a very large business done for all positions. Covering operations have since caused several reactions, but each rise is short-lived as shippers do not support it, and the general tendency of prices is downward. The coming *Baisakhi* crop is reported to be very large and very forward, and arrivals of new shellac are expected to commence in March. We quote 12 per cent,

T. N. Rs. 87 to Rs. 72 done ready; I. T. N. Rs. 92 to Rs. 76 done ready; T. N. Rs. 97 to Rs. 81 done ready and January; Standard 1, Rs. 100 to Rs. 85 value ready; Fines and superfines Rs. 90 to Rs. 95 value ready; Seedlac Rs. 85 to Rs. 78 value ready; Rs. 64 to Rs. 61 done April; Rs. 62 to Rs. 58 done May."

(4) To eliminate the speculators from the field and to make the market stabler it has often been suggested that buying and selling through Government agency or through Co-operative Central Stores might be worth trying. The other simple alternative is to ask Calcutta Firms to buy the stuff direct from the growers. But all these are fraught with great commercial and administrative difficulties. On the one hand lac cultivation must be increased, the price must be kept high to make the cultivation a paying avocation, on the other hand we have no control over the market abroad or over the speculator's interference. Inspite of these incongruities, adversely affecting the lac cultivation, it will, it is hoped, continue to flourish.

NOWGONG, ASSAM: 13*th April* 1928. — A. K. ADHIKARI, P.F.S., *D.F.O., Nowgong Division, Assam.*

TAMBOURRISSA QUADRIFIDA OF MAURITIUS FORESTS, VULGO: BOIS TAMBOUR.

The order of Monimiaceae is represented in Mauritius by two genera only, *i.e.*, Tambourrissa and Monimia. Of the former we have the following seven species, *T. tetragona, T. amplifolia, T. sieberi, T. quadrifida, T peltata, T. elliptica, T. pedicellata.*

With the exception of *Tambourrissa quadrifida* which produces timber, the other species are but small and useless bushes. *Tambourrissa quadrifida* itself is becoming more and more scarce; it is rare that a tree of some height and diameter is met in our forests nowadays. The timber is nearly indestructible and was used in 1907 to 1909 at Kanaka Forest in the manufacture of shingles and railway keys, for which products it was first rate.

Trees dead many years were found with quite sound heartwood although they had been buried under a heap of humus and had lost all their sapwood. The accrescent perianth-sac, which is so particular, reaches sometimes 3 to 12 inches breadth, with a hollow cavity 1 to 6 inches deep, thus forming a sort of receptacle capable of holding a pint of water for several days, and in which monkeys roaming about in the woodland quench their thirst.

The propagation of the species is very difficult on account of its natural enemies, rats, bats and monkeys: as soon as the seeds ripen the pericarps open out.

It is really a sight to see a tall tree in blossom: all the branches and even the stems are provided with hundreds of these funny inflorescences at various places and in different positions and the whole is a wonderful sight. The female perianth remains permanently closed, but the male perianth splits up into its four long lobes, crowded with short, stout, purple filaments, and the ligulate horizontal anther makes it an admirable object of curiosity to study. The leaves are opposite as a rule and the branches follow the disorderly position that nature seems to have cast over that species. Besides animals, men have also contributed to its rarity by cutting the trees for making drums. The tree is now found to a limited extent, only in dense canopied forest.

F. BIJOUX,

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SOME ASPECTS OF FORESTRY IN RUSSIA.

BY V. PELTS.

(Continued from pp. 349—361., June number.)

In the beginning of this article I mentioned that forests in Central Asia are more affected by man than in Europe. This is surprising, but it is a fact. The *saksaul* has completely disappeared within reach of villages and towns. The whole desert believed by travellers to be empty is populated by nomads, who

do not live near roads with their inferior vegetation. From one well to another the average distance is usually ten miles. Only in midsummer when sheep require water daily does the nomad camp near his well. At other times he is five or more miles away he wants to save the vegetation near his well for the midsummer when water is more needed. If one does not know how to locate camps one can ride all day through the desert without finding anyone. Certainly no road leads to any camp, and if there is any well near the road it is an old well in solid ground with salty water fit only for camels.

The biggest *saksaul* trees and the biggest juniper trees in the hill forests are found in graveyards. I published in January 1917 in the Forest Journal of the Forest Institute, Petersburg, some photographs of *Biota orientalis* of immense size, perhaps a thousand years old, found by me on ancient graveyards, possibly of pre-Mohammedan times.

The nomad who lives in the desert cannot exist there without 500 to 1,000 sheep—that is the minimum. Any one who has less could not afford to build a deep well, could not renew it each ten years and could not stay independently in the desert. Usually he has several thousand sheep, and a hundred or more camels, to move the tents and transport charcoal. Poor people stay near rivers, where life is easier, or near towns with chances of occasional employment.

The big broad highland valleys of Chatkal, Alai* and Yagnob—all of them 8 to 10 thousand feet high—are grazed in summer by 4 to 5 million sheep which come hundreds of miles through minor valleys till they reach these favourite places. The total amount of sheep in Turkestan is probably 100,000,000. The result is that in Central Asia with its rather rare population there is no place either in the desert or the hills which would not be penetrated at least once a year by huge flocks of sheep and migrating camps with many horses in the hills and hundreds of camels in the desert. No forest vegetation is, therefore, to be

**Footnote*.—The famous highland valley "Alai" in the Pamir should not be confounded with Altai mountains in South Siberia.

found unaffected except temporarily closed forests for the natural regeneration of juniper.

In any big forest in European Russia one can find trees centuries old a few miles from towns and villages, also in Semiretchye, in the north east of Turkestan in the Tian Shan forest giants are no rarity. But neither in southern Turkestan nor in Kashgaria nor even in the Gobi desert in Chinese limits, supposed to be without inhabitants; in none of these vast territories can forests unaffected by man be found.

As a matter of fact, apart from monumental trees, the best *saksaul* forest I ever met, as to density and luxuriant vigorous growth, was always round an "apan"—an abandoned dead well—and sure enough in the middle of the forest a few miles in diameter there was found a former well. The history is always the same, the well existed ten years (good wells are always in sand), then collapsed, by that time all the bad weak *saksaul* had been exterminated miles round by man and animals. The sand had been worked loose and conditions were created for a perfect growth of new *saksaul* after the owner departed to dig a new well many miles away.

With the juniper forest there is one peculiar difficulty; no young seedlings have ever been found in any district where population is now present. It appears that young juniper is more easily exterminated by animals than any other tree. It is not a case of browsing, it is not, (or rarely) eaten. *Saksaul* can stand being felled 3 to 4 years in succession and the new abundant sprouts browsed by camels for several years. The case of juniper is, however, exceptional, no coniferous forests of any other species are ruined to alike extent. Only the complete closing of valleys for several years produces regeneration.

Of the forests of European Russia at least one-third are now the artificial product of silviculture. All private forests have long been under State protection, no felling being permitted without obligatory rennovation under State supervision and the acceptance of a working plan. In Turkestan these questions did not arise, since all forests had been in the past State property and from the day of occupation were taken over by the new administration, and soon afterwards by forest experts.

Artificial measures of afforestation in Turkestan have been limited, due to the absence, in most districts, of sufficient revenue. In the hills Afforestation divisions have been constituted near Samarkand, Margelam, Tashkent and Ashkabad. In all these the problem was to afforest dry foot hills, by terracing, to prevent devastation of cultivated lands by torrents, and to protect head-works of irrigation channels. Practically all species planted were successful. Ulmus and *Robinia pseudo—acacia* succeeded on the driest slopes. *Pinus maritima* was found satisfactory, also *Juglans regia*.

A failure was *Ailanthus*—a foriegn introduction—which for the first ten years appeared to be growing perfectly. All *Ailanthus* plantations I have seen have gone the same way. No sooner have the trees reached ten years then they dry up and new stems rise from the roots.

These plantations are now about 50 years old. *Saksaul* and other desert trees and shrubs were cultivated only along the Central Asian Railway in Transcaspia (total about 200 miles along both sides of the line). The centre of that district is the railway station Repeteck surrounded by a sea of sand now covered with a dense growth of *saksaul*. I might note that for experimental purposes some *saksaul* trees were planted quite successfully many years ago in the botanical garden in Tiflis in the Caucasus. I have seen them there in a humid climate next to palms and orange trees in rather queer surroundings.

I am not a Russian, by origin, but I must say in concluding this article, that it is only fair to say that the grievances of most minorities were exaggerated and usually aggravated by agitators who were fighting not for the national progress of their country but only for their own political advantage and to create trouble for the benefit of international political organisations.

The general principle was full equality of rights of all nations (the law provided only an exception in the case of the Jews), equality in Government service, and even the Mohammadans of Central Asia and the Caucasus had in the army several Generals commanding European troops.

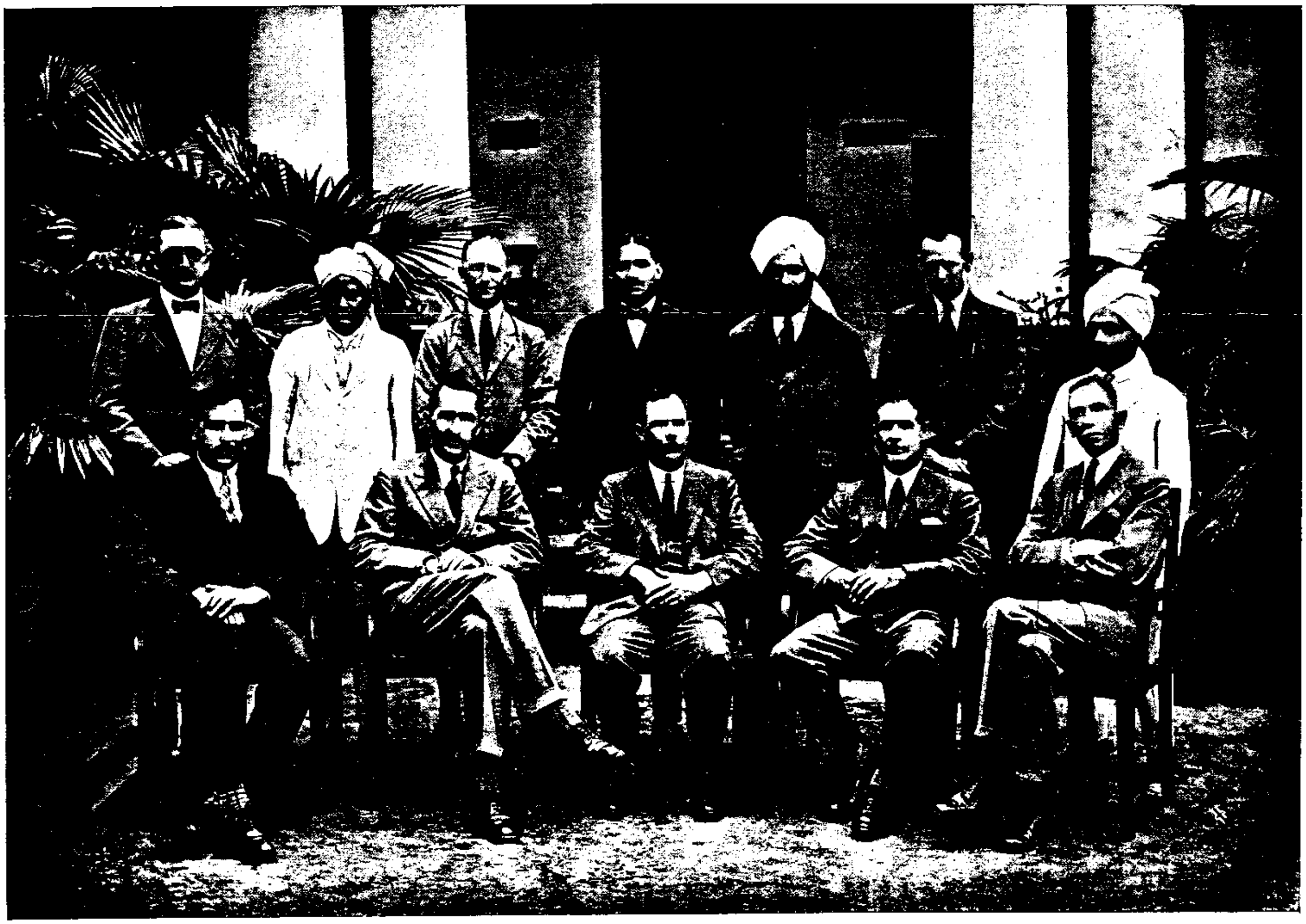
Outside of the Russian dominions there are within the continent of Asia a few points of forest interest I should like to mention, as this should practically complete a rough description of the distribution of forests in Northern and Central Asia. It is of course common knowledge that Persia and Afghanistan are semi-desert areas much like Turkestan. In fact the desert vegetation there is very like the *Saksaul* cum *Calligonum* types in Turkestan, except that the deserts are much smaller, and therefore, practically all dendroid vegetation has been exterminated.

There are two places in middle Asia of a type completely out of keeping with the generality of vegetation; Lazistan on the shores of the Black Sea, between Batum and Trapezond in Turkey, where there is no winter and the rainfall amounts to 200" per annum or even more distributed nearly equally over the whole year. The hills are rounded, of volcanic origin with red laterite soil; here is found abundant dense vegetation, fir and beech on the hills, pine lower down on the cliffs near the sea-shore; the valleys contain a dense growth of sub-tropical plants including *Prunus lauro-cerasus*, orange trees, laurel (*Laurus nobilis*), and many others all interwoven with lianes, wild grapes, *Rubus* (9 species) and countless Rhododendron and *Azalea*. In the lowland palms grow successfully, all the open spaces are covered by ferns (8 species) and moss. Ferns are usually only found in forests, here they take the place of grass. A rocky shore with a thundering surf, a sea with luminescence credited only to tropical seas. In short here are all the characters of the Riviera, Ceylon, and the sea-shore of a tropical South Sea island. Even bamboos and tea have been introduced near Batum.

At the back, Armenia, behind the nearest ranges only fifty miles inland, is cold, dry and identical with the high interior of Persia, a dreary place. Apparently Lazistan is protected by nothing from the cold winds from Russia, from the frozen northern shores of the Black Sea with the ice bound Azow lagune in the Crimea. Its climate is a meteorological puzzle.

The other place deserving mention is Enzeli in North Persia on the shores of the shallow Caspian Sea. On the northern shore the Caspian is frozen and the winter cold in Astrakhan reaches

Group of some Punjab Forest Officers taken on the eve of Mr. Coventry's retirement.



FROM LEFT TO RIGHT.

Sitting.—Khan Fazl Muhammed Khan, B.A., Deputy Conservator of Forests. Mr. A. D. Blascheck, F.C.H., Oec., D., Conservator of Forests. Mr. B. O. Coventry, F.C.H., Conservator of Forests. Mr. W. Mayes, F.C.H., Chief Conservator of Forests. Mr. R. Parnell, Conservator of Forests.

Standing.—Mr. Owen Williams, A.M.I.L.E., Forest Engineer. L. Bakhshi Ram, Rai Sahib, E.A.C., Forests. Mr. L. B. Holland, B.A., Deputy Conservator of Forests. Ch. Allah Bakhsh, Khan Sahib, B.A., Deputy Conservator of Forests. S. Bahadar Singh, E.A.C., Forests. Mr. T. Kirkham Jones, M.C., Forest Engineer. L. Ram Nath, E.A.C., Forests.

temperatures unknown in most parts of Sweden, an icy wind sweeps across the steppes from Siberia, and the country is desert.

At Enzeli and the adjoining parts of the sea-shore in Gilyan no winter is known, all the orchards consist of orange trees, palms grow successfully, and the rainfall is somewhere near 100" or more. The hills behind are covered with Beech Chinar, Oak, Rhododendron. It is the last place Rhododendron is found. Then comes an empty gap till far away Kashmir in India, where *Rhododendrons* again reappear. To the south of Enzeli, the cold and dry highland of Persia for 1,000 miles south to Mesopotamia where again palms are met with.

To the east of Turkestan the snow covered ranges of the Pamir and Tian Shan form the frontier of China. Behind those ranges are Kashgar, the Tarim basin, and the Gobi desert. The desert with *saksaul* and *Calligonum*, as in Turkestan, stretches far half way to the shores of the Pacific. Only on the limits of Manchuria and China proper is the desert replaced by a moister climate due to the approach to the Pacific.

(*Concluded.*)

BIG GAME SHOOTING IN THE INDIAN EMPIRE.

BY LT.-COL. C. H. STOCKLEY.

(Oxford University Press: Rs. 12-6-0.)

This is an uncommonly good book, well planned, and written in a pleasing style. In these days of stress and hard work, it is only the privileged person who is able to shoot throughout India and Burma; and, as the privileged person seldom combines with

his privileges the art of writing and the instincts of a shikari, it follows that books on shikar covering the whole of India are rare. Col. Stockley has produced such a book. He writes "primarily for the man of limited means who follows his game on foot, and wants the essence of sport by doing his following up and finding himself." To keep down the cost of publication he has been obliged to prune and shave, but this has been done very skilfully.

The book is written in two parts. Part I, covering 92 pages, consists mainly of information and advice on the selection of a shooting-ground, the choice of a rifle, the equipment and cost of shikar trips, and how to find, track, stalk or beat, and bag big game. A separate chapter is devoted to shooting in the Himalayas. Part II, covering 104 pages, contains notes on sixty different species of big game, with forty photographs. These excellent illustrations are a special feature of Part II, and greatly augment its value.

In his introduction Col. Stockley discusses the Shooting Rules, and indulges in a tirade against that pestilential species of the genus Homo, the Common Indian Poacher. The remedy he suggests is that the sale of any portion of a wild animal, hide, horns or meat, should be made a criminal offence. We appreciate the spirit of the argument, but doubt that the remedy is a practical proposition. The chapter on Himalayan shooting would have been improved had it included a map of Kashmir, on a suitable scale, to enable the reader to locate the shooting grounds discussed in the chapter.

In dealing with the choice of a rifle, the author brushes aside the double-barrel ·577 and ·500 express rifles as being obsolete and not worthy of consideration. When used with cartridges loaded with low-pressure cordite and copper-tube bullets, these rifles are still amongst the most effective weapons for tiger shooting, and are by no means to be relegated to the museum or the scrap-heap.

Most experienced sportsmen will recognise that the author is well qualified to advise on the *modus operandi* of big game shooting in India, and will find themselves in complete agreement with the advice that he gives. The book is not a mere record of personal

exploits and the capital " I " which is so obtrusive in many recent publications, has to be searched for. The novice will find it brimful of information and sound advice, and even the old shikari can pick up a wrinkle or two, apart from the pleasure that he will derive from a well written book on shikar.

R. B. C.

EXTRACTS.

MALARIA AND IRRIGATION.

Bengal has one splendid lesson to teach all India. Malaria and the coloured water of river floods are sworn enemies. Now this coloured water is more deeply coloured in the early days of the floods than in the later days, and these early days are the critical ones in the life of mosquitoes. Irrigation Engineers have, therefore, an edged weapon to fight malaria with. Clear rain water and clear water which oozes up with the rise of spring level from below are the friends of mosquitoes, just as coloured water is the enemy. Early flood water could combat malaria. The Irrigation department in the Punjab, in my birthplace the Western Doon, and in countless other places could, in the interests of Public Health, allow full supplies of early flood water to flow down the canal and be given free for the first six weeks of the monsoon to everybody who could take it and let it mingle in the fields with the rainwater of the monsoon. This would help to combat malaria and enrich the soil and be a kind of tithe given to God. This flood water coming from above would not hurt spring level. It is the water entering the soil through leakage into the subsoil from canals and distributaries, which comes up from below, which hurts the land. This rise of spring level, I hope, Sir, with your kind permission to discuss later, but now I am dealing with malaria.

How many tea and coffee planters who manage estates at the feet of hills, could lead turbid water from streams and hill water-courses through their plantations and help to keep down malaria

It is the utilisation of this early flood water in watercourses, rills streams big and small, and rivers big and small, which will one day, be the double edged sword to combat malaria and poverty of soil. What India wants to-day are thousands of projects of this kind over the length and breadth of the land. Such projects will bestow the blessings of delta irrigation to every tract they cover. They will lay the foundation and leguminous fodders will be the apex of the structure which will convey health and prosperity to millions of Indian homes.

W. WILLCOCKS.

CAIRO, *22nd April 1928.*

"Indian Engineering," 12th May 1928.

TIMBER SUPPLIES AND EMPIRE TRADE.

TIMBER SUPPLIES OF GREAT BRITAIN.

Lord Parmoor called attention to the recent speech of Lord Clinton, Chairman of the Forestry Commission, on the timber supplies of Great Britain and the decline of private woodlands, and asked whether, as regarded future planting, the noble lord was satisfied, having regard to the public interests and requirements, with the prospects, so far as finance and the other matters with which the Commission were confronted were concerned. From Lord Clinton's speech, and from the seventh annual report of the Forestry Commission, it appeared that the outlook required very serious consideration. The actual timber area, according to the report, was just under 3,000,c00 acres, but less than half the acreage was the only source of anything like an effective supply of timber for public uses. What was to be done in the circumstances? The word "nationalization," he knew, was supposed to have some special vice about it, but he put it forward that if they really wanted to preserve their forests—if they wanted to have their timber supply conserved—they must have it done under public control and ownership. It was very melancholy that their woods should be depleted to the extent that they were. He would like to know whether the Forestry Commission were making experiments as to the character and

nature of trees which would grow and would be likely to flourish in some of the waste or uncultivated areas, say, in Scotland.

LORD CLINTON'S REPLY.

Lord Clinton said there was really nothing new in the speech which he made to the Home-Grown Timber Merchants' Association, but the matters with which it dealt, and which were fully set forth in the annual report of the Forestry Commission for 1926, did represent a very disquieting state of things. The serious feature of the census of woodlands was the amount of the devastated area ; the half-million acres which, at one time or another, had been sold, partly through the War, and partly through other causes—taxation, death duties, and so on—and had not been replanted. That was a very serious matter. The Commission were dealing with those areas as they came to them, and they were quite alive to the importance of getting them.

There was another census which the Commission had not yet published, but the figures of which were in his mind, and which showed how their home forests were being worked at this moment. About 55 million cubic feet were being produced from these forests. Roughly, that would mean the felling of something like 25,000 acres, but the only area which was being planted was about 12,000 acres a year. Therefore, there must be a constant and annual diminution even of the small forests which existed in this country. That was going on all over the world. The whole world was, in fact, day by day, year by year, cutting into its capital of timber—(hear, hear)—and was not replacing or regenerating to anything like a sufficient amount. Therefore, some day or another, whether it be near or far, that capital would be exhausted, and they would be in very grave danger of a famine unless the States really took upon themselves the responsibility of looking far enough forward to provide the timber that was required.

The noble lord's remedy was some form of nationalization. The main objects of a forest policy could be achieved either by a form of nationalization or by private ownership, or by a combination of both. It was the latter which was now being adopted in

this country. There was not the least advantage in adopting a policy of nationalization at present. The Forestry Commissioners were buying and planting as many acres as the State could give them money to deal with. They could do that better under present conditions than by spending a stupendous sum, possibly £100,000,000, in buying out the present private owners of forests and adopting a policy of nationalization. He was confident that the forest policy was here to stay, but it must be for the Government to say what the future of forestry would be during the next ten-year period. (Hear, hear.)—(" *The Times*.")

LUMINOUS WOOD.

A specimen of luminous wood, sent by Mr. J. E. Hosking, F.L.S., was exhibited. The specimen had been taken from a tree that had been lying for some time on leaf-mould in a wood at Ham Street. Mr. Hosking had noted that many other parts of the same tree were equally luminous.

Mr. J. Ramsbottom explained the luminosity as due to the invasion of the timber by the fungus *Armillaria mellea*, and, in reply to questions by the President and Mr. R. H. Burne, stated that luminosity in fungi was caused by the same reactions of luciferin and luciferase as occurred in animals; the luminosity was continuous if the temperature was above freezing-point and in the presence of oxygen.

Mr. Miller Christy referred to barn-owls sometimes appearing luminous on account of particles of luminous wood from the lining of their nest-holes adhering to their plumage.
(Linnean Society of London, General Meeting, 1st December 1927.*)*

ALBINOS AT THE ZOO.

A PROMISED WHITE TIGER.

Albinism, or the absence of pigment in an individual of a normally pigmented race, has been noticed in almost every kind of animal. Sea-anemones, worms, molluscs, lobsters, and many kinds of insects as well as of fishes, reptiles and amphibians, birds and

mammals sometimes produce white individuals There is an extreme case in which albinos when paired give rise only to albino offspring, so that pure-bred albino races may be established.

Familiar instances are Mexican axolotls—the curious amphibians which usually breed in the larval or immature condition, and of which there are examples in the Aquarium at the Zoo—white rats and mice, and white domestic rabbits. The white elephant recently exhibited at the Zoo was albino with a certain amount of pigment. The white cobra, one of the most beautiful, creatures ever exhibited at the Zoo, was almost a pure albino, with pink eyes, but it had a little pigment in the skin behind the head and on the "hood."

Polar bears are not albinos, as their eyes are normally dark, and they are to be compared with the white winter forms of foxes, hares, many small carnivore, and ptarmigan. In a similar category must be placed the pale or white forms of animals of different kinds living in caves or cellars where there is no light. In all probability a distinction should be made between true albinos which have lost the power to produce pigment, and creatures which are white in whole or in part either because of accidental defects in their own constitution or from the absence of some external stimulus necessary to the production of pigment.

The most attractive albinos belong to groups of animals in which the blood is red. The absence of pigment makes the eyes transparent and the red blood shines through. Probably it is this condition of the eyes which has given rise to the belief that albinos are constitutionally weak. They shun strong light, and often look unhappy in its presence, screwing up their faces and sometimes moving in a hesitating way. But there is no real evidence that they are really weaker than their normal fellows. It is an odd circumstance, moreover, that their normal fellows seem not to notice any difference in their white companions. Albino and normal birds and mammals recognize each other perfectly, and are quite ready to be companionable or to inter-breed.

The London Zoological Society seldom makes any special efforts to buy albinos, partly because exaggerated values are often set on these rarities, which may be very beautiful. But it was a

great disappointment a few years ago when a white tiger, said to be a pure albino was promised but did not arrive. The society has owned both African and Indian albino monkeys, the example of which a photograph is given (not reproduced) being an Indian monkey. The porcupine is not a pure albino, but is a very handsome creature. The white squirrel certainly is an albino red squirrel, but albinism seems to be unusually common in rodents. White jackdaws are also not uncommon, but are seldom pure. White peacocks have been fancied for centuries, and there seems little difficulty in breeding them. It is certainly the case that normal peacocks or peahens show no reluctance to take an albino mate.—(" *The Times*.")

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WOODEN VERSUS IRON SLEEPERS IN INDIA.

Few Divisional Forest Officers are probably cognisant of the struggle which is developing between the wood and the iron railway sleeper in this country, a struggle with which the Forest department of most provinces is vitally concerned. It is estimated that the Indian railways use about one-third of the output of our forests and should the market for wooden sleepers be lost the effect of throwing this additional quantity of timber on the general market could only result in the most deplorable slump in prices.

In 1924 27,475,000 B. G. wooden sleepers were in use on Indian railways against 27,099,000 cast iron, steel and other kinds. Since then there has been an increase in the number of metal sleepers used and a comparative decrease in the number of wooden sleepers. During the last few years cast iron and steel sleepers have been obtained at prices with which, considering the much longer life of metal sleepers, wooden sleepers cannot compete. In the case of M. G. sleepers the case is not so acute; figures for 1924 were 29,884,000 wooden and 8,119,000 other kinds. This was because hitherto the metal M. G. sleeper could not compete with the wooden sleeper in annual cost. Now, however, the case is becoming somewhat altered and even M. G. metal sleepers are being obtained at prices that seriously rival wooden ones.

The Forest department seems to have taken too little notice of this threat to their trade in the past, it is obvious that this state of affairs cannot continue and that the competition must be faced. We no longer have a monopoly of the supply of sleepers and in

order to keep our trade it is surely in the interests of the Forest department to do everything that can be done to encourage the use of wooden sleepers. It is not to our interest to fight for a high price for sleepers, when this will merely drive the railways to the use of metal ones. We should be satisfied with a fair price and if possible one which is competitive with the price of the iron sleeper. In this connection we have much pleasure in publishing in this number an article by Mr. W. A. Bailey, Deputy Conservator of Forests, attached to the Railway Board, on the use of "Half Round Sleepers". This article is also being published in the "Quarterly Technical Journal" issued by the Railway Board. At the same time we would urge the Indian railways to consider their specifications for wooden sleepers, which to any one acquainted with American railways, are absurd. The great majority of the wooden sleepers in the main line of the Canadian Pacific Railway and the Canadian National are of a class that under no circumstances would be accepted by Indian railways, yet the engines and rolling stock in Canada are far heavier than in India.

We would earnestly call attention to the American railways' specifications for cross ties given in Chapter XII of Brown's "Forest Products—their manufacture and use." An easier specification and the adoption of the half round sleeper would increase the supply of wooden sleepers, lower wastage and conversion cost and so enable the Forest department to sell more wooden sleepers at a lower cost, to the benefit of both parties. Given a wooden sleeper produced in India at a competitive price it is not unreasonable to expect the Government of India, of which the Railway Board is a part, to support its own Forest department. Many thousands of Indian work-people are employed in the timber trade and considerable revenues are derived from the public forests. It is surely preferable for Government to support this trade and purchase sleepers in India than to send abroad large sums for imported iron. This policy of Swadeshi is being constantly urged in the Legislature, yet does not appear to have been thought of so far as the dealings of the Railway Board with the Forest department are concerned; perhaps this omission will now catch the eye of the watchful Pundit.

A PRELIMINARY REPORT ON THE PERIDERMIUMS OF INDIA AND THE OCCURRENCE OF CRONARTIUM RIBICOLA FISCH. ON RIBES RUBRUM LINN.

BY A. HAFIZ KHAN.

This paper is intended to serve as a preliminary report on the present position of the Indian Peridermia and their alternate hosts. It is primarily intended for the use of forest officers to whom a general idea of the nature and life history of these fungi is of importance. Their help and co-operation is also invited in the investigation of certain phenomena on which our knowledge is very incomplete. Special efforts have been made to eliminate all technical terms as far as the nature of the work has permitted.

In May 1923, Dr. W. McRae, Imperial Mycologist, Pusa, forwarded us a reference from Dr. E. J. Butler, Director, Imperial Bureau of Mycology, Kew, England, suggesting the possibility of the occurrence of *Peridermium strobi* Kleb. as indigenous on *Pinus excelsa* in the Himalayas. It was presumed that the Peridermium which has been found on the stem of *P. excelsa* in India might be identical with *P. strobi,* the aecidial stage of *Cronartium ribicola* Fisch., which attacks several members of the five-needled pines in Europe and America.

From a perusal of the correspondence which took place on this subject between Dr. McRae and Dr. Butler on the one hand and between the latter and Mr. Stuart-Moir and Dr. Colley, United States Department of Agriculture, Washington, on the other, it transpired that the point was originally raised by Moir who found in the Botanical Museum in Paris a uredo and a teleuto stage of *Cronartium asclepiadeum* (*Willd*) Fr. on a leaf of Ribes which closely resembled *Ribes rubrum* It was collected by Jacquemont from the North West Himalayas and determined by Lévéillé.

This was apparently the basis from which Moir thought that *P. strobi* might also be found in India and its teleuto stage on one of the Indian Ribes. He accordingly drew Butler's attention to this interesting subject with a view to making a careful enquiry

and elucidating the problem. The latter, considering that the investigation was of forest importance entrusted it to us.

In response to his desire the work was taken in hand at once. Mr. R. N. Parker, Forest Botanist, kindly explained the situation to the Divisional Forest Officers, Kulu, Upper Bashahr and Hazara divisions, where both Ribes and *P. excelsa* grow, and requested them to have a search made for the fungus. Luckily this soon met with success and on 3rd September, of the same year, specimens of leaves of *Ribes rubrum* were sent in by Mr. Greswell, Deputy Conservator of Forests, Hazara, bearing brown spots on the upper surface and well developed columns of *Cronartium ribicola* Fisch. on the corresponding area below. It was later verified at Kew and America. The specimens were collected from Kamalban Range, Upper Kagan, Hazara, at about 7,500 ft.

The life history of this fungus has been thoroughly worked out in Europe and America and it has been conclusively proved that it is the teleuto stage of *P. strobi* which attacks several species of the five-needled pine, of which *P. excelsa* is one.

HISTORICAL ACCOUNT.

Peridermium is a familiar name to most of us, particularly to those who happen to work in the coniferous forests of the Himalayas. It is known to have existed in this country for several decades. The earliest reference to it that can be traced from the literature available in our library dates as far back as 1852. During this year the first example of the fungus seems to have been described by Hooker [1] under the name *Aecidium Thomsoni*, subsequently known as *Peridermium Thomsoni*, Berk., on *Picea Morinda*. It was collected by Dr. Thomson from the Sikkim Himalayas. I regret I could not obtain access to Hooker's original publication but have seen a reference to it made by Barclay in a footnote of his paper. "On a Uredineae affecting the Himalayan spruce fir (*Abies Smithiana*)" [2]. The fungus causes a good deal of deformation in the effected parts. Only the current years' shoot is attacked which assumes a distinct drooping habit. The needles are also similarly deformed and greatly turned back. The aecidia are pro-

1 Hooker, J. D.—Gardener's Chronicle, 1582, p. 627.

2 Barclay, A.—Jour. Asiat. Soc. Bengal, LV., Pt. II., No. I.

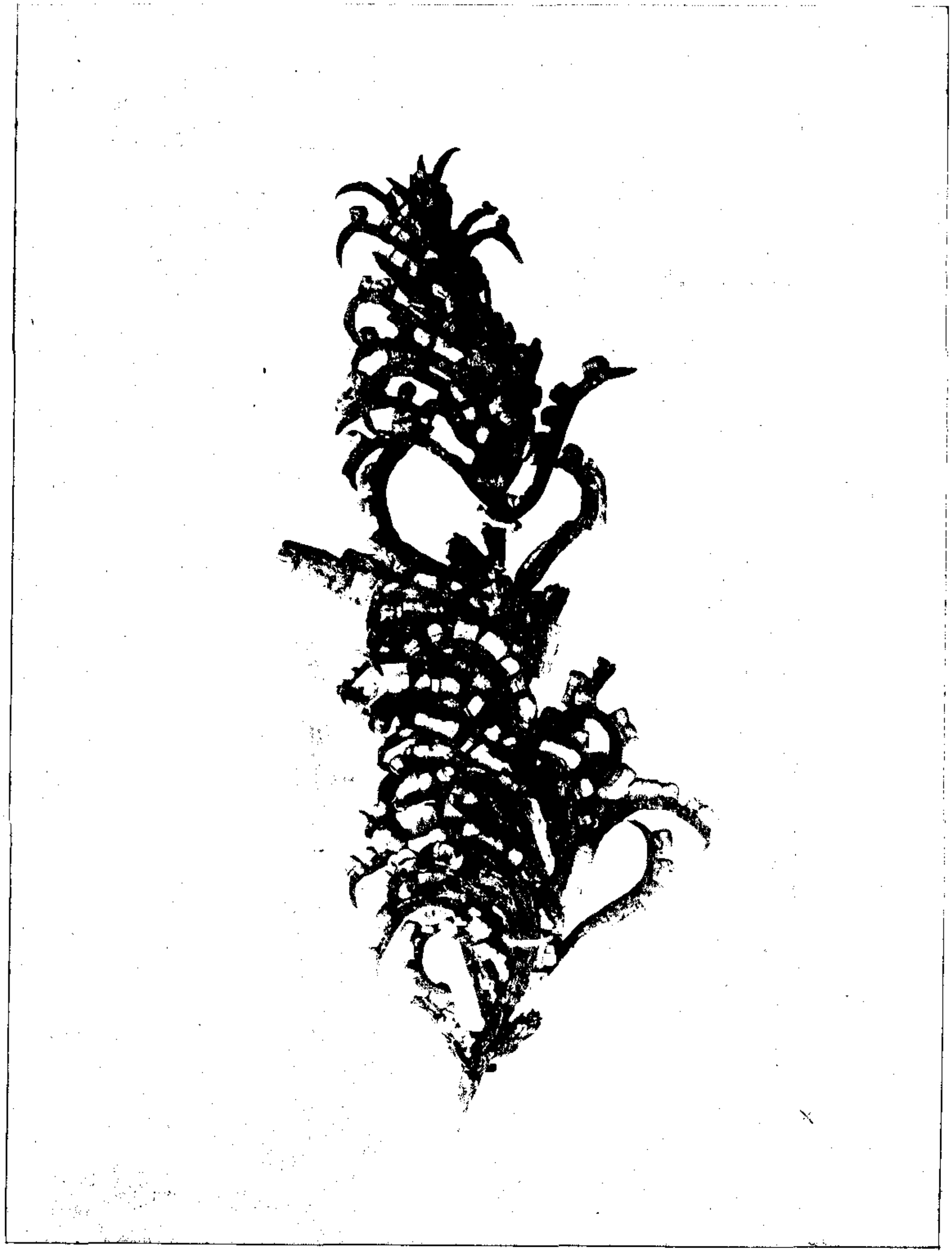

Photo. by Harswrup 17-4-28.

An infected shoot of *Picea Morinda* showing æcidial pustules of *Peridermium Thomsoni*. (*Enlarged*).

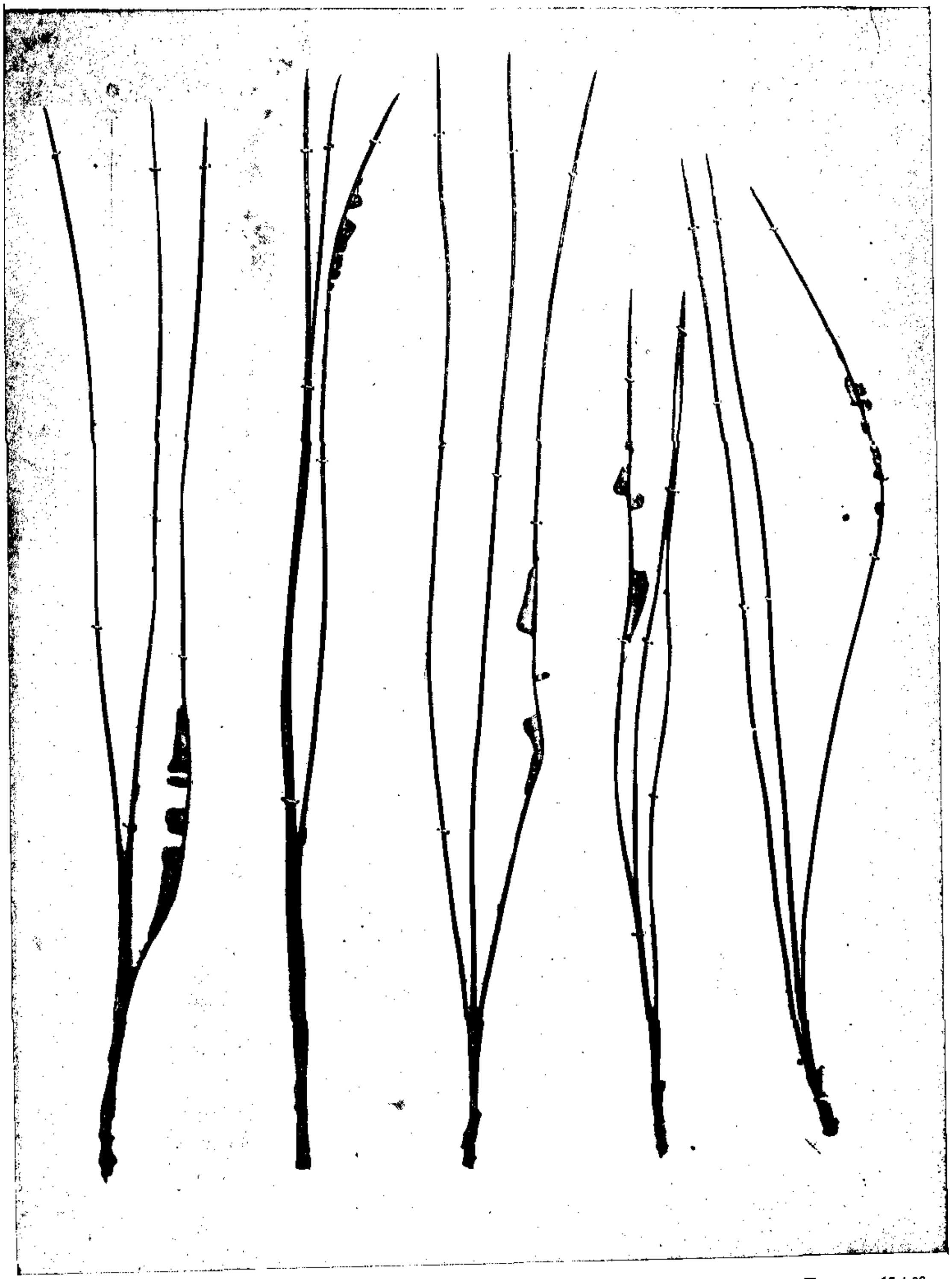

Photo. by Harswarup 17-4-28.

Aecidial pustules of *Peridermium complanatum* on the needles of *Pinus longifolia*.

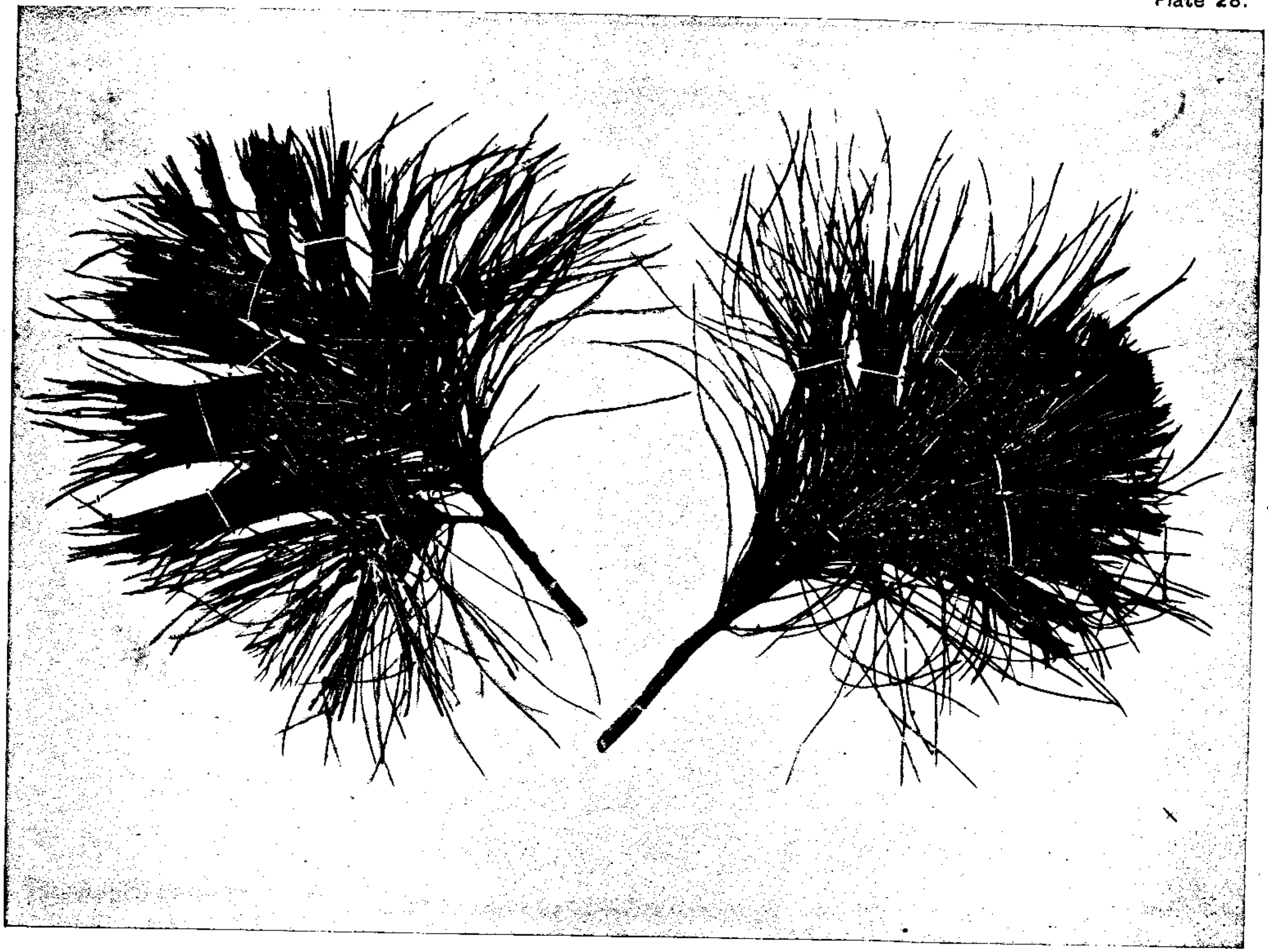

Photo. by Harswarup 17-4-28.

Two infected shoots of *Pinus excelsa* bearing æcidial pustules of *Peridermium brevius* on the needles.

duced in two rows on the upper surface (Plate 26.) They are generally preceded by spermogonia which appear at the tip of the needles [3].

It was not long after this that reports of the occurrence of other species on different hosts, in various parts of the Himalayas began pouring in with the result that to-day Peridermium occupies a considerable area stretching from the boundaries of Bhutan in the East to Gilgit, and perhaps Afghanistan in the West, including some of the Sub-Himalayan tracts as well.

The next collection was made by Gamble in 1878. He apparently found two allied fungi on the needles of chir (*Pinus longifolia)* and kail (*P. excelsa*) at Anandale and Mashobra, Simla, and sent them to Cooke for identification. The latter considered both specimens to be identical and called them by a common name *Peridermium orientalis* [4].

In 1890, Barclay during the course of his investigations in the neighbourhood of Simla, apparently came across the same rusts on the needles of chir and kail which Gamble collected in that locality in 1878, as mentioned above. After a careful comparative examination he disagreed with Cooke's determination and regarded both specimens as distinct from each other. Accordingly he split up Cooke's *P. orientalis* into two separate species and named the one on chir as *Peridermium complanatum* [5] (Plate 27) and that on kail as *Peridermium brevius* [6] (Plate 28). This view was generally accepted. In their general appearance they look very much alike except that the latter has much smaller peridia. The leaves are not altered in any way.

In the same paper the author has mentioned a stem-form on Chir which he apparently thought was a variety of the leaf form. He remarks:—

> "This aecidium on the needles of *P. longifolia* is extremely common in Simla, indeed it is rare to find the host free from it. I have once only seen it on the stem (var. *corticola*)."

3 Butler, E. J.—Ind. For XXXI, p. 612.

4 Cooke, M.C.—Ind. For. III. p. 91.

5 & 6 Barclay, A.—Descript. List of Uredineae in the neighbourhood of Simla, No. 2, 1890, pp. 101-102.

No descriptions of it are available anywhere so that it is impossible now to form any idea as to what led Barclay to arrive at this conclusion. As regards the stem-form on *P. excelsa* he said he never observed any.

During the same year he described two new species. *Peridermium Cedri* [7] and *Peridermium Piceae,* [8] on deodar (*Cedrus Deodara*) and *Picea Morinda* respectively. The latter is quite different from *P. Thomsoni* which has been mentioned in the beginning of this paper and therefore represents a second species on this host. It is not a common fungus and the Dehra Herbarium is rather poor in it. The aecidia are long and narrow and are found rather irregularly and not in two rows. No deformation is produced. Plate 29 shows the effect of *P. Cedri* on deodar. The majority of the needles of the affected rosette are curved downwards and contrast strikingly with the neighbouring healthy ones. The aecidia are small and develop on the upper surface of the needles.

In 1895 Nisbet [9] found a Peridermium on the stem of *P. longifolia* and another on *P. excelsa* in Jaunsar and called them as *Peridermium pini corticola,* perhaps thinking that both specimens belonged to the same fungus. He seems to have based his conclusions on the general similarity of the Himalayan species with that of Klebahn's [10] *Peridermium pini* (*Willd*) *f. corticola ex. p.* on *Pinus silvestris* as figured in *Pflanzen-familien II. p. 41* by Engler and Prantl. But it is now practically certain that both Indian specimens are distinct from each other, as stated above, and that Klebahn's fungus does not grow in this country. They, therefore, cannot be identical.

There is a mounted sheet* in Dehra Herbarium which bears the following information :—

" Imperial Forest Research Institute and College, Dehra Dun.

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7 & 8 Barclay, A —loc. cit. p. 104.

9 Nisbet.—Ind. For. XXI. 1895. p. 132.

10 Klebahn, H.—Kulturversuches mit heterocischen Uredineen Zeitschrrift fur Pflanzenkrankheiten II p. 259, 1892.

* Since been forwarded to Dir. Imp. Bu. Myc. Kew, or identification.

Photo. by Harswrup 24-4-28.

An infected branch of *Cedrus Deodara* showing deformed rosette above caused by *Peridermium Cedri* and normal needles below. Aecidia not developed yet.

Peridermium brevius Barc. var. *corticola.*
on *Pinus excelsa* Wall.
From J. Nisbet, Deputy Director, Forest School.
Lambatach, Chakrata ; 10,000 ft.
Date. May 1894 (See Ind. For. XXI, 1895, p. 132)."

This shows that the specimen was certainly collected by Nisbet and might have formed a portion of his original collection, but who named the fungus is not known. It is obviously a mistake to call it *P. brevius*, a name which Barclay gave exclusively to the leaf-fungus, without a comparative study. In the "Silviculture of Indian Trees" Troup [11] has repeated the same mistake but he has only taken the name from other works. He found the stem-form on *P. excelsa* in Kulu in 1914 and a little later in Hazara although the exact locality is not given. As late as May 1927 Mr. H. G. Champion collected a small seedling, about 18 inches high, heavily attacked by Peridermium on the stem, from Thandiani, Hazara District, at 8,000 ft. and in the following September the writer found it at Kamalban between 7,500 and 8,000 ft. Troup's Kulu specimen exists in the Pusa Herbarium but there is no trace of his Hazara specimen anywhere. The Jaunsar, Thandiani and Kamalban specimens are in Dehra Dun. They have been sent in part to Colley for determination.

Referring again to the incorrect identity of the fungus Dr. Butler* says "I have in my notes a reference to a specimen at Pusa of *Peridermium complanatum Barc.* var. *corticola* on stem of *Pinus excelsa*" but further comments "This Peridermium ordinarily attacks *P. longifolia* and it is quite likely that the Pusa specimen on *excelsa* is wrongly determined." It is quite clear from the above facts and also from the literature available that leaving the leaf forms on chir and kail which have been definitely named by Barclay [12] the stem-forms have never been properly examined and the names allotted to them from time to time were apparently based on their general resemblance with either the Indian leaf-forms or other foreign species.

11 Troup, R S.—Silviculture of Indian Trees, III, p. 1026.
* Official correspondence.
12 Barclay, A.—loc. cit.

Another species which occurs on *Ephedra vulgaris* in Chakrata is *Peridermium Ephedræ* (Plate 30.) It was collected by Gamble and determined by Cooke [13] in 1895. This is the only species which has been recorded on a non-coniferous host. Other stages are unknown at present. The aecidia appear all round the shoot and are very small in size and cylindrical in shape. It induces a " witch's broom."

Finally we have a Peridermium on the stem of the Khasi pine (*Pinus Khasya*) in Assam. It was sent by Rai Bahadur Upendra Nath Kanjilal, Extra Dy. Conservator of Forests, in 1918 and identified at Kew as *Peridermium* (*near cerebrum*) (Plate 31.) It was found associated with special large " burrs " on the stems.

This is a brief historical account of all the Indian Peridermia known up to date and the statement below gives in tabular form the host and the locality of each fungus.

Serial No.	Fungus.	Host.	Locality.
1	*Peridermium Thomsoni* ... Berk.	*Picea Morinda* ...	Sikkim, Jaunsar, Kashmir, Kulu, Punjab.
2	*Peridermium Piceæ* Barc.	*Picea Morinda* ...	Chakrata, U. P.
3	*Peridermium Cedri* Barc.	*Cedrus Deodara* ...	Kathiyan, Jaunsar, Kulu, Punjab.
4	*Peridermium complanatum* Barc.	*Pinus longifolia*, (needles).	Ranikhet, Naini Tal, Kumaon, Kasauli, Rawalpindi, Simla, Palampur, (Kangra) Punjab. Mussoorie, Dehra Dun, U. P.
5	*Peridermium himalayense* Bagchee	*Pinus longifolia*, (stems).	Naini Tal, Kumaon, Jaunsar, U. P., Pauri, Garhwal.
6	*Peridermium brevius* Barc.	*Pinus excelsa*, (needles).	Chakrata, Mussoorie, U. P.
7	*Peridermium indicum*, Colley and Taylor.	*Pinus excelsa*, (stems).	Jaunsar, U. P., Kamalban, Thandiani, Hazara, Kulu, Punjab.
8	*Peridermium Ephedrae* Cke.	*Ephedra vulgaris*	Karamba, Jaunsar, U. P.
9	*Peridermium* (*near cerebrum*)	*Pinus Khasya* (stems).	Khasi Hills, Assam.

13. Cooke, M. C.—loc. cit. p. 95.

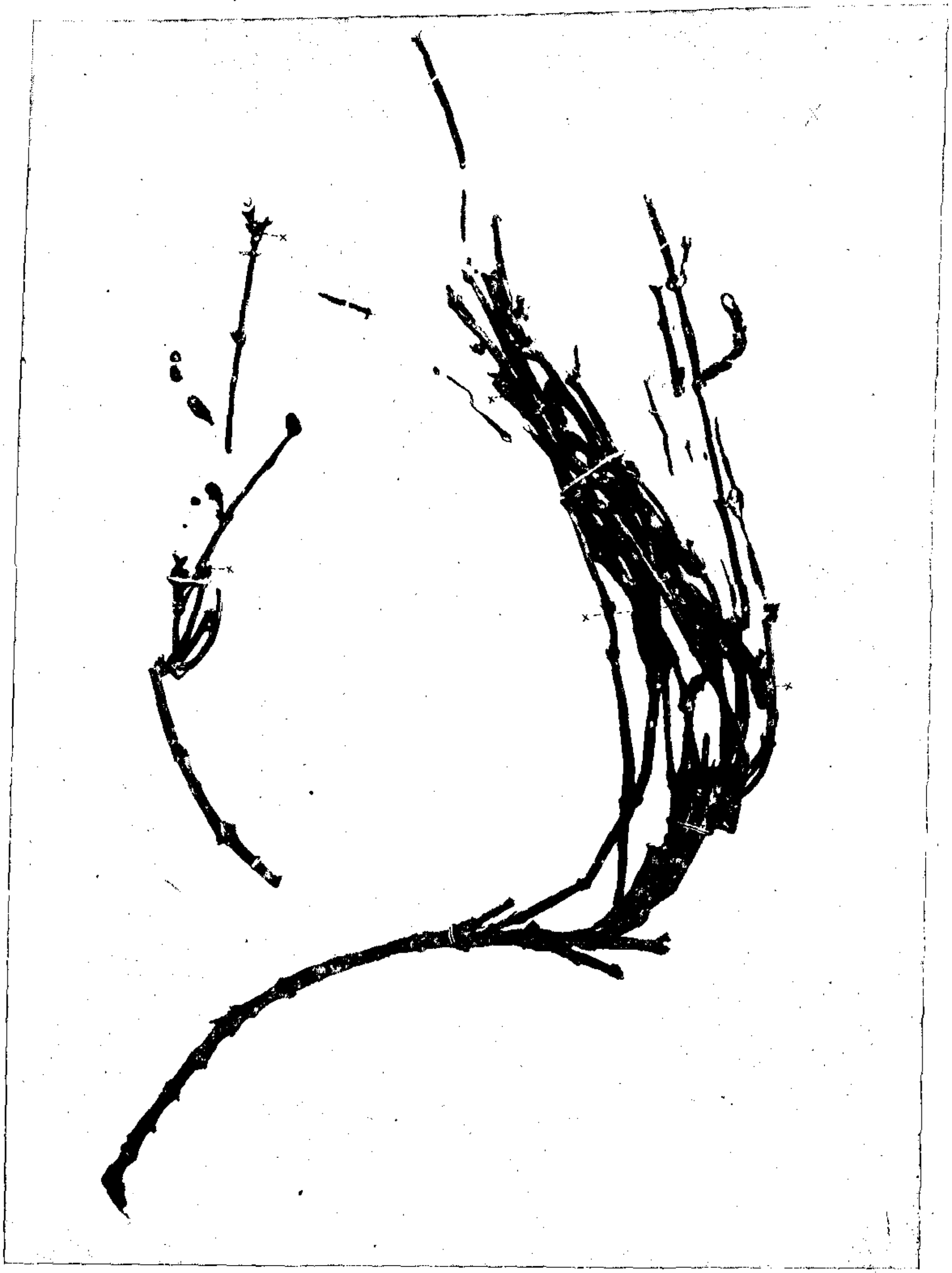

Photo. by Harswarup 17-4-28.

Peridermium Ephedræ on *Ephedra vulgaris.*

The position of æcidia which are very minute is indicated by cross marks.

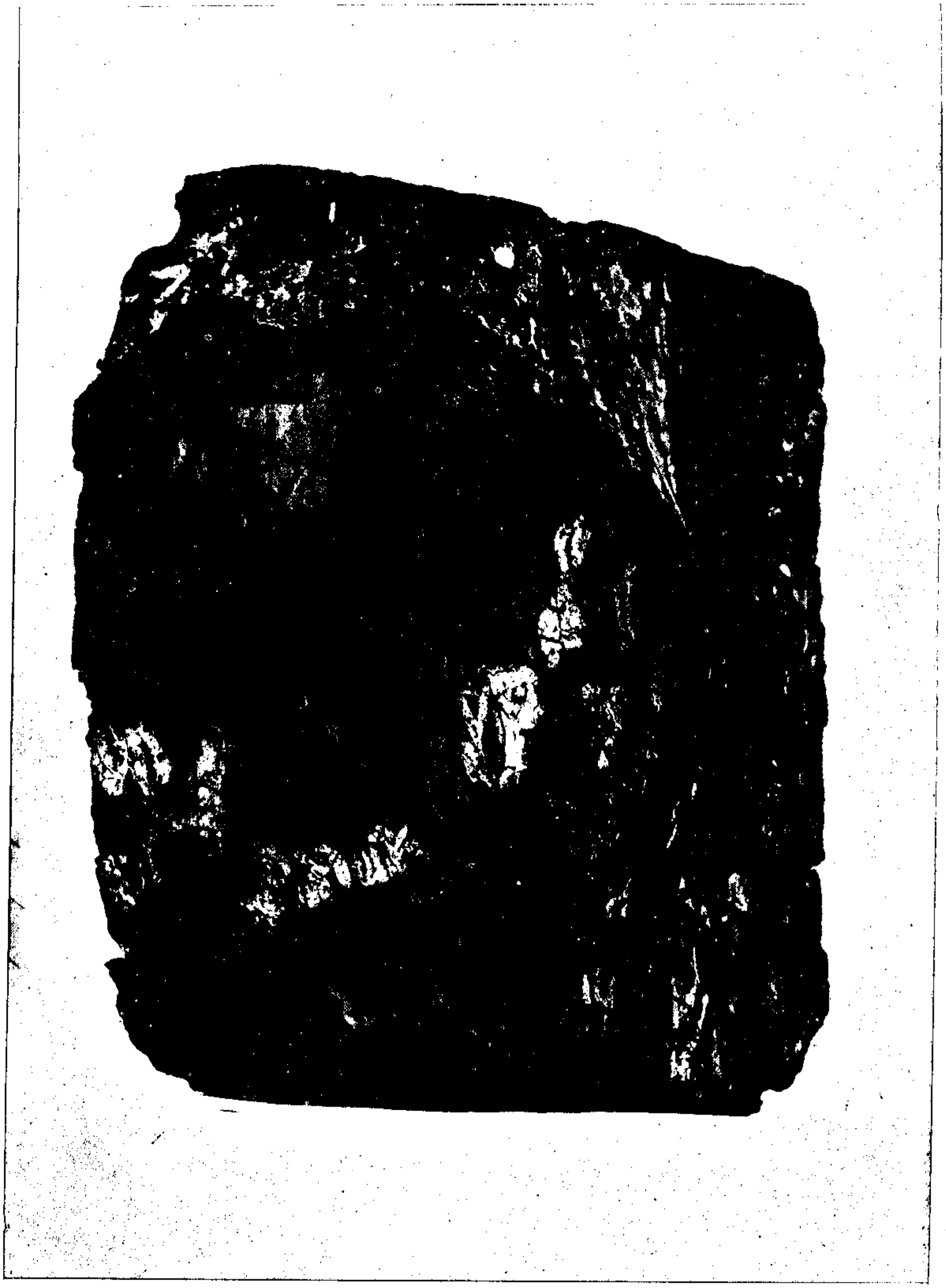

Photo. by Harswarup 17-4-28.

A portion of a "burr" of *Pinus Khasya* showing large white scars left after the destruction of æcidia of *Peridermium (near cerebrum)*.

LIFE CYCLE.

Peridermium belongs to the family of Uredineae, more commonly known as rust fungi, the members of which are all true parasites. There is such a high specialization of parasitism in this class that a number of biological forms have evolved among them which in their general appearance and microscopic character would look exactly similar but will infect only particular hosts. It is typically heterœcious, that is requiring more than one host to complete its life cycle, and is only a stage in the development of its perfect form. A completely developed fungus of this group has five distinct spore forms or stages.—(1) Spermatium, (2) Aecidium, (3) Uredo, (4) Teleuto and (5) Sporidium.

Spermatium.—On germination the sporidium gives rise to a special mycelium which will infect only a coniferous host, grow in the tissues and eventually produce innumerable small tiny black or brown dots on the needles and stems, according to the parts attacked. These are called *Spermogonia.* Inside each of them myriads of minute colourless spores are formed which are known as *Spermatia,* a single one is called a *Spermatium.* Their true function, however, is still a disputed point since they are said to be incapable of infecting and producing disease. They usually precede the aecidial stage.

Aecidium.—From the same mycelium, which gives rise to spermogonia, the aecidial stage next develops. It is characterised by the formation of large prominent orange coloured blisters, sacs or pustules as they are called, on the needles and stems both. Each pustule is a separate individual and has a strong wall within which the spores are enclosed. It is a true aecidium but on account of its shape, the irregular manner of splitting of the covering and other characters the name Peridermium has been assigned to it. It appears as early as February and continues to grow till June. After this the fungus entirely disappears with the fall of the needles. The stem-form, however, persists for a much longer time though eventually dying out with the close of the monsoon.

Barclay [14] mentions a second minor crop of the leaf-form

14 Barclay, A.—loc. cit. p. 101.

in November in Simla but this does not seem to occur in Dehra Dun, where the fungus, as a rule, appears in February and is always preceded by Spermogonia. In Simla the Spermogonia usually appear with the November [15] crop.

Uredo stage.—As soon as the peridia or aecidial pustules are ripe they burst and the spores are carried by wind. Alighting on a suitable host, *not a conifer*, and provided the conditions are favourable, they germinate, infect and produce the uredo crop. No sack or blister are formed at this stage. The pustules here are much smaller, powdery and usually rust coloured. Sometimes both uredo and teleuto forms occur together.

Teleuto stage.—This is the final stage. It usually develops in the winter season and is easily recognised on account of its special type of fruit bodies (fructifications) which may be yellow, reddish, brown or orange-red flat pustules, cushion shaped or columnar outgrowths sticking out on the surface of leaf petioles etc. or waxy crusts. Each teleuto-spore on germination produces a small secondary spore which has been termed "*sporidium*" above. This again germinates and infects a *coniferous host*, as stated above, and repeats the cycle.

Peridermium on the stems of Indian pines.

According to Troup [16] there are five kinds of pines in India. Of these, three, *Pinus Gerardiana*, *P. longifolia* and *P. excelsa*, are Himalayan and the remaining two, *Pinus Merkusii* and *P. Khasya* are restricted to Assam and Burma, Since we are now concerned with those species which are subjected to the attack of Peridermium on the stem only, *P. Gerardiana* and *P. Merkusii* go out of court at once as they are not known to bear any rust in India as yet. This leaves *P. longifolia*, *P. excelsa* and *P. Khasya* to which all further remarks will apply. The needle forms on *longifolia* and *excelsa* have been already named by Barclay [17] so that there is no dispute regarding them.

15 Barclay, A—loc. cit.

16 Troup, R. S.—loc. cit. p. 1013.

17 Barclay, A—loc. cit.

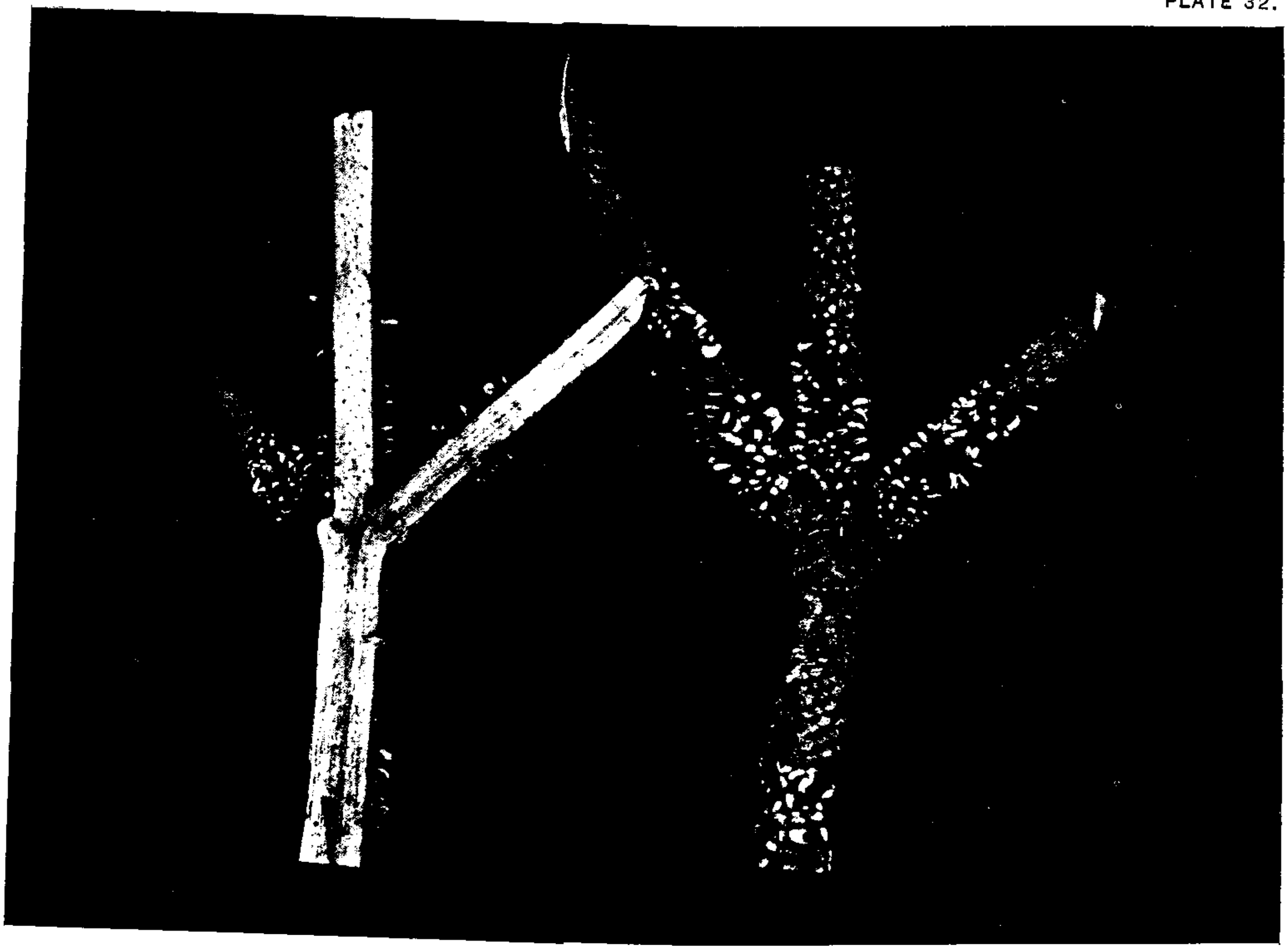

Photo by Harswarup June 1927.

A young branch of *Pinus longifolia* studded with the æcidia of *Peridermium himalayanse*.

A young seedling of *Pinus excelsa* showing swelling and æcidia of *Peridermium indicum* on the stem.

*Peridermium Himalayense Bagchee.

On the stems of Pinus longifolia.

This is the fungus which Barclay thought was the stem form of *P. complanatum*. But it was evidently only a presumption as he does not seem to have described it anywhere. It is undoubtedly a distinct species, having nothing in common with the leaf-form. It is indeed the most common and destructive of all pine rusts in this country. Young saplings and poles are severely attacked and killed outright. Older trees are seldom invaded. The affected parts produce a certain amount of spindle-shaped swellings which are confined to the bark (cortex) only. The fruit bodies (fructifications) arise in the beginning of the hot weather often commencing from April and lasting up to the end of the rains though in a mutilated fragmentary state owing to weather conditions. They consist of innumerable conspicuous orange red (when fresh) pustules sticking out horizontally like small blunt spikes which emerge through the bark cracks (Plate 32.) The stem exhibits special deep fissures in such places with all the appearance of a canker. It is a dangerous enemy of young plantations and nursery stocks. The teleuto stage is unknown.

The fungus has been reported from Chakrata, Simla and Kumaun at present.

Peridermium Indicum Colley and Taylor.

On the stems of Pinus excelsa.

This fungus has attracted special attention after the discovery of *Cronartium ribicola* at Kamalban. It occurs on young seedlings and small saplings of *P. excelsa* which is the only pine of the *strobus* group in India—a point which perhaps aroused Moir's suspicion regarding its identity with *P. strobi*. In its general appearance and behaviour it resembles the foregoing species but the microscopic characters differ considerably (Plate 33.) It is not a common fungus at present and the damage

* Bagchee, K.—Investigations on the infestations of *Peridermium complanatum* Barclay and *P. himalayense* n. sp. on the stem of *Pinus longifolia*, Roxb. Communicated.

caused by it is not serious but it cannot be overlooked on this ground. As a matter of fact every effort should be now made to study its life history and devise means of eradicating it before it becomes a regular pest. In Kamalban where the author has observed this fungus, a marked tendency to increase has of late been noted. Saplings which appeared to be perfectly healthy and sound about four years ago are gradually developing the fungus now. And if it continues to grow at this rate it will not take long to assume a threatening position.

Like the last species this has also been sometimes named after the leaf-form. This practice, misleading as it was, had so mixed up the two forms that it has been impossible to tell one from the other. In order to remove this confusion Troup's Kulu specimen was sent to Dr. Colley from Pusa and the other specimens were forwarded by us through the Director, Imperial Bureau of Mycology, Kew, for a thorough examination. At the same time inoculations with *C. ribicola* on *P. excelsa* were carried out at Mussoorie and Kamalban to determine the genetic relation, if any.

As a result of the examination of the Kulu specimen Colley and Taylor have published a paper in the Journal of Agricultural Research in which they have demonstrated by means of microscopic sections and measurements of peredial cells and spores, based on morphological and biometric studies, that the Himalayan species is distinct by itself and have assigned a new name, *Peridermium indicum* [18], to it. Nothing has been heard of the Jaunsar specimen as yet. The Thandiani and Kamalban specimens have only recently been sent for verification on which a report is shortly expected and will be communicated in a future publication should they differ from *P. indicum*.

This identification has changed the position altogether and it now appears that the *excelsa rust* is not connected with *C. ribicola* in India. Consequently we have to make a renewed effort to find the alternate stages of both fungi to solve the problem.

18 Colley, R. H. and Taylor, Miss Minnie, W.—Jour. Agri. Res. 34. No 4 193 pp. 327—330.

The Paris specimen of *C. asclepiadeum* on Ribes which Moir* says he has seen in the Botanical Museum would be interesting in this connection. But unfortunately I have neither seen the specimen nor any account of it and therefore am not in a position to offer any comments. It, however, appears that this is the only record of this fungus on this host. According to Grove [19] Cornu, Klebahn and others have shown that in Europe *C. asclepiadeum* (uredo and teleutostages) occurs on *Pæonia officinalis* in gardens and the aecidial stage, *Peridermium Cornui*, on the branches of *Pinus silvestris*, which is a two-needled pine. They also remark that the uredo and teleutostages can infect *Vincetoxicum*, *Nemesia*, *Cynanchum*, *Verbena* and as well as many species of *Paeonia*.

Saccardo [20] originally described it on *Vincetoxicum officinale*, *V. purpurascens* and *Gentiana asclepiadea* but in 1925 he revived Thumen's old name, *Cronartium gentianum Thum* [21], and treated *C. asclepiadeum* as a synonym. In this volume *Gentiana asclepiadea* and var. *albiflora* are mentioned as host plants. No mention of Ribes has been made by any of them.

As regards the inoculations with *C. ribicola* a number of tests have been made from Ribes to kail at Mussoorie and Kamalban. Mussoorie has been particularly selected for this purpose as it is believed to be free from the stem-form of Peridermium nor is there any Ribes within a radius of several miles which would interfere with the experiment in any way. Up to date no definite results have been obtained and it is, therefore, proposed to defer details till more complete data have been collected. Meanwhile attempts should be made to observe the sequence in which the Peridermium precedes or follows other rusts on broad-leaved trees, shrubs and herbs within a reasonable distance. The expression "reasonable distance" is certainly very vague but there is no definite information available on this

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* Official correspondence cited.

19 Grove, W. B.—The British Rust Fungi, 1913, p. 314.

20 Saccardo, P. A.—Syll. Fung. VII, p. 597.

21 Saccardo, P. A.—Syll. Fung. XXIII, 1925.

point. Spaulding [22] has quoted the opinions of various authors in connection with the distribution of aecidiospores from which it appears that they may be carried by wind up to several miles, but a distance of 500 to 1000 ft. is perhaps supposed to be a more effective range. It is advisable that in making such observations the work should be started from the close vicinity of the infected pine or Ribes and extended outwards. Any help received from the forest officers in this connection would be greatly appreciated.

Incubation period.

The pine rusts, as a rule, take a long time to fructify. If the infection occurs one year the fruit bodies usually appear after several years. This interval which elapses between the date of infection and the formation of peridium is called the *incubation period.* It may extend from 1—5 years or more. McCubbin [23] describes it as follows:—"First season, infection; second season, dormant period; third season, swelling stage; fourth season, swelling stage; fifth and following seasons, aecidia." It is, therefore, of great importance that all observations should be continued for at least five seasons before drawing any conclusion.

PERIDERMIUM (NEAR CEREBRUM).

On the stems of Pinus Khasya.

This fungus was identified at Kew from a rather mutilated specimen which was received from Assam in 1918. It was associated with a large woody excrescence or "burr" almost the size of a football. Galls of this nature were reported on this host as early as 1914 but the actual causative agent was never worked out and it still remains obscure. The study of Peridermiums is always a difficult subject and takes a long time to produce results but the investigation has now been taken in hand by the department and it is hoped that each species will receive its full share of attention in due course.

The writer offers his thanks to Dr. Bagchee for filling in foot-note no. 9 while on tour at Pusa, which could not be done at

22 Spaulding, Perley.—Bull. No. 957, 1922; pp. 33—35, U. S. Dept. of Agriculture.

23 McCubbin, W. A.—Phytopathology, VII, 1917, p. 100.

Dehra for want of the necessary literature and also for permitting the use of Plate 27.

HALF ROUND SLEEPERS.

Messrs. Allum and Parker in the Report of the Sleeper Enquiry Committee of 1923-24 strongly advocated the use of half round sleepers and referred to them in the summary of principal recommendations. Para. 72 of this Report states :—

> "To increase the range within which railways can obtain Indian timber we invite their consideration of the 'half round' sleeper, which is simply a log of small diameter sawn through the middle into two sleepers; teak sleepers of this description are "already in use on the Bombay side, chiefly by metre gauge railways, and to a small extent on the B. G. section of the B. B. and C. I., and the Chief Engineer of this Railway, Mr. Arnould, says they are the best sleepers he has."

More recently the Eastern Bengal Railway have taken a considerable quantity of sal half round M. G. sleepers, supplied to them by the Eastern Sleeper Group.

Existing specifications for such sleepers state that "the absolute minima after adzing for rail seat should be width 8″ and depth 5″ for broad gauge and 6″ and 4½″ respectively for metre and narrow gauge." The Report, however, states that "a more practical specification, which we believe is in use on a metre gauge railway, that depends on half round timber for its sleepers, would lay down a minimum width of base and a minimum depth, both exclusive of sapwood, within 6 inches on each side of each rail seat." This specification is practically the same as that in use for the M. G. sal half round sleepers supplied by the Eastern Sleeper Group.

Now the number of such sleepers that could be obtained and their price depends very largely on two points (1) the minimum dimensions (width and depth) required at the rail seat, (2) whether

sapwood is permitted or not. Taking the first point, dimensions at rail seat ; it may be assumed that after adzing for rail seat, depths of 5" and 4½" for B. G. and M. G. sleepers respectively will be required as minima. The question, therefore, will depend on the minimum width required at the rail seat. If too high a minimum, such as 8" for B. G. sleepers is required, the log that produces the sleepers comes into a class that will produce good quality square sawn scantlings and, therefore, half round sleepers could not be produced either in large numbers or cheaply. Provided the sleeper has sufficient depth and strength, and the wood is hard, it is a question whether a wide bearing surface is required. An examination was recently made of a certain number of half round *B. G. teak sleepers in the Bombay and Bulsar divisions* of the B. B. and C. I. Railway. The result of this was that 40 % of the bearing surfaces were 6" and under in width, while in some cases the bearing widths were only 4". These sleepers have been in use for 10 years and upwards and are still considered excellent sleepers. Sal is 53 %, and teak 33 %, stronger and stiffer as a beam than deodar. Also sal is 165 %, and teak 66 %, harder than deodar. It is, therefore, clear that a sal or teak half round B. G. sleeper, 5" deep and with a minimum bearing width of 6" at rail seat compares favourably in strength and stiffness with the standard 10" × 5" deodar sleeper. Similarly it is suggested that the minimum bearing width for M. G. sleepers should be 4½". It should be remembered also that these are minimum dimensions, the majority of sleepers supplied would have dimensions exceeding these minima. Trees rarely produce perfectly cylindrical logs, so there would be a considerable range between the minima dimensions prescribed and the maxima that would be taken or supplied.

Let us now consider the second point, that of sapwood. The width of the sapwood zone varies in trees of different ages, and in trees grown in different localities. For logs of the size that would be required to produce half round sleepers of sal and teak, it may be taken that the width of the sapwood zone would be about one inch. A log 11¾" in diameter would produce two half round sleepers 5" deep and with 6" bearing width includ-

ing sap wood; to get a 6" bearing width exclusive of sapwood a 13¾" diameter log would be required. To exclude sapwood would, therefore, again prohibit the supply of large numbers of cheap sleepers.

It is generally known that sap wood is not durable, but what is not generally known is that the difference between heartwood and sapwood is merely one of durability. Dr. H. P. Brown, formerly Wood Technologist of the Forest Research Institute, Dehra Dun, a recognised authority, states in the footnote to page 44 of his "Elementary Manual on Indian Wood Technology" that:—

> "The last growth ring at the end of the growing season is as lignified as it will ever become and no further changes of this character ensue as it passes over eventually into heartwood. The corollary follows that sapwood, being as lignified as heartwood, is fully as strong under identical conditions of moisture."

All that is required, therefore, is some preservative treatment to make the sapwood durable. The Forest Research Institute, Dehra Dun, have experimented with the treatment of sal and find that sal sapwood is easy to treat, taking up the preservative mixture readily, whereas it is practically impossible to get any penetration into the heartwood. If, therefore, sal sleepers with sapwood were treated the preservative would not be wasted as only the part requiring preservation, *i.e.*, the sapwood, would take up the preservative. It is believed that similar information is not at present available concerning teak.

The chief item of expenditure in a sleeper treating plant is the cost of the preservative used. In this case only one-third of the preservative would be required compared with what is required to treat a chir B. G. sleeper, as a sal half round B. G. sleeper, as above described, would have only about one cubic foot of sapwood. The cost of treating such sleepers with a half and half mixture of creosote and liquid fuel oil, as used in the North Western Railway treating plant at Dhilwan, may, therefore,

be estimated as follows (figures from page 43 of the Report of the Sleeper Enquiry Committee) :—

	Rs.	a.	p.	
Interest and depreciation on plant ...	0	3	6	per B. G. sleeper.
Labour	0	1	6	"
Stores and other operating expenses ...	0	1	6	"
Treating mixture, $9\frac{1}{3}$ lbs. at Rs. 5-4-0 per cwt.	0	7	0	"
Supervision	0	1	0	"
	0	14	6	"

Similarly a M. G. half round sal sleeper would contain about three-fifths of a cubic foot of sapwood and the cost of treatment is estimated at Re. 0-10-0 per sleeper.

Nothing has so far been said about the width of the base of the sleeper. The minimum dimensions of 10″ for B. G. and 8″ for M. G. sleepers would be easily obtained as the minimum logs which would produce these sleepers would be $11\frac{3}{4}$″ diameter and about 10″ diameter for B. G. and M. G. sleepers respectively. The trouble would be in the majority of cases that the sleepers would be too wide at the base. If considered advisable this could be easily rectified by adzing off the corners to maxima of about 12″ and 10″ respectively, an operation that could be readily and inexpensively carried out in the forest.

The question should now be considered from the point of view of the forest owner or forest contractor. Of the many factors that affect the economic working of forests two important ones are the cost of production of the sawn material and the possibility of making a full utilization of the produce. In both of these the half round sleeper has a decided advantage over the standard square sawn sleeper. The cost of sawing, which is a heavy item in the production of the standard sleeper, is reduced to a minimum. Material that cannot at present be utilized for square sawn sleepers, especially in localities where there is not a good market for small wany scantlings, can be more fully utilized in the production of these sleepers. It is believed that

all forest owners and contractors would be quite ready to undertake the supply of these sleepers as it would be distinctly to their advantage to do so, provided a reasonable specification is adopted.

It is not easy, without going more carefully into the matter, to give an estimate of the numbers that would be available and the cost, but it is believed that at a conservative estimate the number of teak and sal sleepers now available could be increased by about 25 per cent. and the cost of the half round sleeper should be about two-thirds only of the cost of the present standard sleeper. Treated half round sal sleepers, as described above, would be easily the best wooden sleeper on the market.

W. A. BAILEY, I. F. S.

PRIZE DAY AT THE BURMA FOREST SCHOOL, PYINMANA.

The annual prize distribution took place at the Burma Forest School, Pyinmana, on Tuesday, May 1st. The Minister for Forests, Mr. Lee Ah Yain, travelled to Pyinmana from Rangoon to attend the function.

The Minister was accompanied on the platform by the following officers: Mr. H. W. A. Watson, Chief Conservator of Forests; Mr. C. H. Philipp, Conservator of Forests, Central Circle; Mr. N. V. Holberton, Conservator of Forests, Delta Circle; Mr. G. S. Shirley, Provincial Silviculturist; Mr. C. W. Scott, Deputy Conservator of Forests, Utilization Circle; Mr. D. E. B. Manning, Deputy Conservator of Forests and Director, Burma Forest School.

DIRECTOR'S ADDRESS.

The Director of the school, Mr. D. E. B. Manning, opened the proceedings with the following address:—

Mr. Ah Yain, Mr. Watson, ladies and gentlemen,—To-day is the 15th prize day since the Forest School was moved to Pyinmana from Tharrawaddy, and the 27th since the school was first opened. It is also the third year that we have had the pleasure of seeing the present Hon. Minister for Forests at Pyinmana.

The Burma Forest School started at Tharrawaddy in 1898, with about 8 students, to-day, we have a total of 65 students, while a further increase in the Vernacular Class from 25 to 40 students has been sanctioned this year. The increase in number will commence with the new class which comes to the school in May 1929.

The English Class started in May 1926 with 12 students, of these 9 have obtained certificates, two have been awarded honours and one student has been removed.

These men pass out as Probationary Rangers for two years on Rs. 100 a month, and if found satisfactory, will then be promoted Rangers, on Rs. 120 a month rising to Rs. 275 a month with prospects of still further promotion.

The Vernacular Class started with 25 students, of these 24 have obtained certificates and one has been awarded honours.

These subordinates pass out as Deputy Rangers on Rs. 50 a month, with chances of early promotion to the charge of a Range.

The usual course of instruction was followed throughout the year. Nearly seven months were spent in the forests on tour, while the lecture terms in Pyinmana lasted for three months. During the last two years, afternoon lectures in camp, on the work in hand for most part, have been more frequent than formerly. In time, it may be possible to extend these, so that the daily number of lectures during term may be reduced.

Mr. Lloyd was in charge of the school till the 10th of April, and his detailed report of the year's work has been laid before the Board of Control. It only remains for me to point out some of the more interesting items.

The second year students visited the Government timber depôts at Rangoon and Mandalay, and some of the most important forest divisions in Lower and Upper Burma, during November. I wish to express the thanks of the school to Messrs. Steel Bros. for allowing us to visit their mill and light railway at Swa; to Messrs. MacGregor and Co., for arranging demonstrations of timber extraction; to U Ba Oh, for allowing us to visit his mill and light railway at Sabein, and finally, to all the Divisional

Forest Officers in the divisions we visited, for the trouble they took in making arrangements for us.

The students spent a day in Mandalay with the Burma Sappers and Miners, and I would like to thank Major Clarke for the trouble he took in arranging demonstrations for us. The students learnt a great deal from watching Major Clarke's Field Company at work. He has very kindly arranged with his successor that we should spend a week at Mandalay next November.

The usual course in First Aid of the St. John's Ambulance Association was given to all students by qualified doctors. Thirty-three students entered and thirty-one obtained certificates.

Two students were removed on account of continued ill health and one died at his home during the October vacation, with these exceptions, the general health of the school was good.

The new pumping station in the school gardens provides an ample amount of water, but the quality is as bad as ever, and chlorination is still necessary.

The extension of the arboretum has been continued in the grounds adjoining the school nursery. There are now, over 150 tree species which have been named in English and Burmese.

Several new specimens have been added to the school museum during the year. Mr. Lloyd has given a mounted sambhur head, with the object of starting a collection of the animals and birds of the Province.

Nearly 2,000 people from all parts of Burma visited the Museum during the year.

At the annual sports held in October, three new records were established by first year students. Maung Ba Chit broke two records, the 100 yards in $10\frac{2}{5}$ seconds and the 220 yards in $25\frac{4}{5}$ seconds. Maung Sun won the mile in 5 minutes and $44\frac{2}{5}$ seconds.

Forty-eight students entered for the 10 mile marathon race and eighteen finished within one and a half hours. The winner's time was one hour and fourteen minutes.

Football, as usual, was the most popular sport. The school team played eleven outside matches and only lost three games.

The section football league was played off during the rains and a new basketball competition started. Mr. Lloyd has given a challenge shield for this.

The usual half hour's drill has been continued every morning during term.

Finally I wish to thank Mr. D'Silva, on behalf of the school, for the energetic and efficient way in which he his managed the School Athletic Club and the duties of House Tutor.

I will now ask you, Sir, to distribute the certificates.

The Director's speech was translated into Burmese by U Po Thit, A.T.M., Instructor and Extra Assistant Conservator of Forests.

The certificates were then distributed to the successful students of the 1926—28 course by the Chief Conservator of Forests.

SPEECH BY CHIEF CONSERVATOR.

Mr. H. W. A. Watson, Chief Conservator of Forests, then made the following speech.—

Mr. Ah Yain, Mr. Manning, ladies and gentlemen,—On behalf of the Forest department I welcome the Hon. Minister for Forests and thank him for having found time to attend this function. I next thank the Director for his very interesting report.

Mr. Lloyd has just vacated the post of Director on proceeding on leave. He has been attached to the school for almost five years and has held the post of Director for the past two years. During this period the school has made marked progress and the students owe him a deep debt of gratitude. Mr. Lloyd's enthusiasm for education has been a great asset to the Forest department in Burma. Recognition of his ability is not confined to this province. He left Pyinmana less than a month ago and is probably lecturing at Oxford to-day.

I must also acknowledge with gratitude the kindly interest that Major Clarke, R. E., until recently in command of the Burma Sappers and Miners, has taken in the work of the School and the value of his co-operation in the training of the students in Engineering.

The report on the work of the year has been satisfactory. Discipline has been good and progress has been maintained. I have read with pleasure Mr. Lloyd's tribute to the work of his staff and in particular to that of Mr. D. W. D'Silva. The second year Vernacular Class is to be congratulated on having finished its two years course without a casualty. I am disappointed to learn that more advantage has not been taken of the boxing lessons so kindly given by U Hman and that little use had been made of the library. Last year I emphasised the value of boxing lessons in building up character but my words must have fallen on deaf ears.

The object of the school is to provide trained men who can perform, efficiently, the various duties concerned with the management of the forests and who will eventually fill the important range charges.

I have often emphasized the important position that the range officer occupies in the machinery of the Forest department and it is matter for gratification that the Resolution of Government on last year's Annual Report recognizes this position. The range is the unit of executive control. The whole work of the department depends on the efficient management of the range.

The training at the school supplies a groundwork of theory combined with practice which should enable you, prospective range officers, to grasp the objects and reasons that underlie your work and should help you to develop an interest in your work. It is hoped that you will respond to this training by applying what you have learnt in a commonsense and practical manner. Forest management requires continued observation and study of the many factors concerned with the life of the forest, the climate, the different soils, and the trees and undergrowth that grow on each kind of soil, the influence of birds, animals and insects on the growth, and last but not least the influence of the wants of mankind on the forest. This study will not only make your life interesting but will increase your value as forest officers. Above all a proper interest in your work is required. Without this interest you become at best slaves to executive work. Pride in

your work and initiative will lead to promotion. There is little merit in mere routine slavery.

When you become range officers you should look on your range as an estate which it is your business to manage and develop systematically to the best of your ability. To do so you must have a clear understanding of the policy underlying all orders concerned with the management. You should ask your Divisional Forest Officer to explain anything that is not clear and you should take every opportunity to talk over all matters pertaining to your work with him.

You should keep in touch with the people living in or near the forest and their wants and should think out how these wants can be met from the forests with the fewest restrictions and the least injury to the forests. You should explain the policy to these people and the reasons for restrictions in extractions. You should do your best to enlist their co-operation. The success of your work depends largely on this co-operation which can only be obtained as a result of care and patience on your part and a knowledge on the part of the people that they can trust you. Co-operation is essential to smooth working and you should take every opportunity to meet officials and traders and discuss matters with them. Discussion of outstanding points is more likely to lead to understanding and settlement than writing.

Before concluding I must again remind you that as forest officers you are responsible for the protection of the animals and birds in the forest, as well as the trees. I trust that you will do your best to see that these animals and birds get fair treatment.

I now wish the outgoing students every success in their future career. Life in the Forest department offers one of the few opportunities of leading a free and natural existence in a world in which we are all more or less slaves bound to the wheel of industrialism.

Medal and Prize Winners.

After the speech had been translated into Burmese the medals and prizes were presented by the Minister for Forests.

The medalists and prize-winners were as follows :—

Government Silver Medals.—English Class.—(1) The best 2nd year student in Forestry—Sao Ohn Kyi. (2) The best student in Forest Engineering and Surveying.—Sao Ohn Kyi.

Vernacular Class.—(1) The best 2nd year student in Forestry. —Maung Aung Gyan. (2) The best student in Forest Engineering and Surveying.—Maung Aung Gyan. "The U Po Hnit gold medal" for the best student in the English Class.—Sao Ohn Kyi.

Gold medals and prizes by private donors.—"The old students' gold medal for the student in the Vernacular Class most likely to make a good Forest Officer"—Maung Ngwe Thee. "The Indian Forester Prize" for the best practical Forester in both classes.—Săw Tun Sein. "The J. E. Du Bern Gold Medal" for the best Athlete".—Saw See Ta.

FOREST MINISTER'S ADDRESS.

The Minister for Forests then delivered the following address.—

Mr. Manning, Mr. Watson, ladies and gentlemen.—It has given me very great pleasure to be able to take part at the annual prize distribution of this school. The report of the Director discloses the fact that the students have maintained the high traditions of the school both in the field of studies and sports, and I congratulate the Director and his devoted staff on the result of their achievement.

I am very much gratified to observe that for the first time in the history of this school a first class forest rest house at Zalokkyi was constructed by the students of this school and I am sure great credit is due to all concerned. I mentioned last year about the preservation of the Fauna and I regret to state that there has been little improvement in the general situation. Since the close of the year the new Burma Game Rules have appeared and instructions have been issued with the object of regulating the use of guns and I hope that these rules will be effective, but the success of protection must depend largely on the creation of public opinion in favour of a more general obser-

vance of the rules for the preservation of the Fauna. It should be the main object of the newly created Game Warden to endeavour to create and face public opinion to this end and eventually to form an association for the preservation of the Fauna with non-official members of all communities on the committee of management.

I should like to impress upon the students who have passed out this year the fact that the system of training through which they have passed, is designed and arranged to require of them and to impress upon them, the necessity of mastering each day's allotted work with the object of developing in them those powers of concentration and application, which are necessary for successful accomplishment. They could not have succeeded here had they at any time during their course put off until to-morrow those tasks which were prescribed for to-day ; the same rule must continue to be their standard if they hope to succeed in measuring up the future duties that will devolve upon them. The course of study and instruction, however, is not such as to warrant the sanguine and self-confident student in believing that when he receives his diploma, he is the possessor of all knowledge. On the contrary, he has the bare beginning of knowledge—the foundation of a structure yet to be raised. The clearer this revelation is made to them, the sooner they will perceive that they have merely been taught how to acquire and use kowledge, and that successful accomplishment can be attained only by continuing the method of constant earnest effort, the better will be their chances of success.

In the final test of actual experience it is upon the man himself that success depends. No system of training will carry an incapable or an unfaithful man to success. I hope they will remember the fact that the world to-day is above all else a practical world and it demands results. What it is looking for is men who can and will do things, and not men who are fearful of an undertaking, who advance reasons for not doing it or express doubts about its accomplishment, but men who have the courage of their convictions and will find ways to carry it through successfully.

I now wish the outgoing students every success in their new career.

This concluded the proceedings and the visitors dispersed to inspect the school museum and the students' work which included collections of botanical specimens and economic forest products.

The Minister accompanied by the Chief Conservator visited the school nursery and arboretum and the new water supply pumping station and finally inspected the new gymnasium in the sports field.

PAGAL GYMKHANA.

In the afternoon a pagal *gymkhana was held in the school* grounds.

The Chief Conservator of Forests and a large number of guests were entertained by the school staff.

The students' families and their friends and a large crowd from Pyinmana were present and showed much enthusiasm over the various events. The pillow-fighting over water was keenly contested and caused much amusement.

Amongst the various competitions the tent-pitching and hut-building were the most popular.

A few rounds of light sparring and boxing by students were also arranged.

The tug-of-war, yearly won by the second year team, was very even and for the only time on record the first year students made an impression on the rope, in fact they got within 3 inches of winning, this exhausted them so much, however, that they let go *suddenly*.

Mrs. McLean very kindly consented to present the prizes. The Director thanked Mrs. MacLean for her kindness and called for three cheers which were given with much enthusiasm.

The Chief Conservator ended the proceedings by calling for three cheers for Mrs. Manning who had arranged for the entertainment of the numerous guests of the school staff.

The Honorary Secretary of the School Athletic Club, Mr. D. W. D'Silva, is to be congratulated for arranging such an excellent programme for the Gymkhana.

An *anyein pwé* was given by the students in the evening and a very large crowd attended.

D. E. B. MANNING,

Director, Burma Forest School, Pyinmana.

(*Rangoon Gazette.*)

SILVICULTURAL SYSTEMS.

BY R. S. TROUP, F.R.S.

(Oxford at the Clarendon Press, price 21 shillings.)

Professor Troup has completed the work commenced by him in his "Note on some European Silvicultural Systems with suggestions for improvements in Indian Forest Management" published in 1916 when Assistant Inspector General of Forests in this country; and has now brought out the above comprehensive work in which he deals with the well-known standard systems and their present day modifications.

The lack of such a book in the English language has long been felt, not only in educational circles both in the United Kingdom and in India but also by Indian forest officers, more especially by those responsible for the development of Indian Forest Management. Not that they might imitate what is done in other countries, but by knowing the latest developments of scientific forestry in Europe be able to adapt the general principles of management to the special conditions with which they are concerned. As Professor Troup says, "The close study of European systems does not imply that they should be followed slavishly under all conditions; a proper understanding of these systems, however, is an essential preliminary to their adoption in such modified form as may be indicated by local conditions."

The book devotes a chapter to the clear cutting system and then passes on to the consideration of shelterwood systems with natural regeneration. As has already been pointed out in this journal the present day tendency in Europe is to abandon clear cutting with artificial regeneration in favour of natural regeneration under a shelterwood with a mixture of species including beech. The disaster which has overtaken Saxony and their policy of clear cutting and the planting of spruce is dealt with on pp. 18—21. This policy was introduced by Cotta at the beginning of the nineteenth century. The first result of this system was the disappearance of the tender beech and silver fir, their place being taken by spruce, so that large areas of mixed forest and even beech forests were converted into pure spruce. Already in 1820 Cotta viewed the position with alarm. By 1869 the reduction in growth in young spruce plantations began to be observed and by 1920 the increment had fallen to such an extent that in certain cases woods had to be placed two quality classes (out of five) below the assessment of 30 years previously. These facts are well worthy of consideration by foresters in the British Empire many of whom are occupied in transforming natural forest either into plantations of exotic conifers or into pure teak. We cannot believe that clear cutting with planting of exotic conifers on a short rotation will be the future forest policy of England (essentially a broad-leaved country); nor that any of the private afforestation companies of New Zealand will be able to continue clear cutting on a rotation of 30 years. Clear cutting is under certain circumstances an excellent system, it is only when it is abused that disaster is to be feared but the fate of Saxony may well be taken as a warning.

Passing on to shelterwood systems the author traces the decline of the Uniform and Group systems in favour of Strip systems based more or less on Wagner's *Blendersaumschlag* which system was originated at Gaildorf in 1902 and consists in regenerating the compartment in narrow strips against the sun. This system is now the most fashionable in Europe and has replaced, in whole or in part, the two older systems. Even in Kelheim, the Mecca of group enthusiasts, the classic group system reproduced in every text-book has been modified under Wagner's influence,

We have seen the most perfect results obtained by following Wagner's system; on the other hand we have seen the management thrown into confusion by attempting to regenerate in strips when the whole compartment wanted to regenerate itself at once in a uniform manner. In our opinion the wise forester will refuse to be the slave of fashion and will continue to carry on his regeneration in the simplest way avoiding all unnecessary complications. Chapter IX dealing with the Selection system will be of much interest to those Indian Foresters who were brought up on this system and who at one time, at any rate, were inclined to think that selection was the only system worth consideration. Troup assumes the detached attitude of a judge in the fierce controversy which is still proceeding between the champions of selection and its opponents, an attitude with which we are in entire agreement. In our practice we have employed both the up to-date selection system with uneven-aged woods and the uniform system with even-aged regeneration over the whole compartment, so that we are partisans neither of one school nor the other. We use that system which will give the required results under the special conditions being dealt with and pay no regard to fashion. We cannot do better, therefore, than reproduce Troup's summing up on p. 116 of his "Silvicultural Systems":—

"Very divergent opinions have long prevailed as regards the merits of the selection system. Selection fellings have been condemned on many occasions from the middle ages onwards. Several German writers of the eighteenth century condemned the selection system because it caused damage in felling and because it removed the best trees, the latter objection obviously referred to fellings of the exploitation type. A Darmstadt Ordinance of 1776 prohibited it altogether, and in 1787 it was laid down in Prussia that evenaged crops should be grown in order to produce even growth. G. L. Hartig and Cotta, in the end of the eighteenth and beginning of the nineteenth centuries, were definitely antagonistic to the system. The Baden Forest Law of 1833 prohibited the selection system, and this prohibition is still on the statutes, though it is now ignored. In 1883 the French administration directed that

the selection system should be regarded as the exception, and that the uniform system should be adopted as a general rule unless there were special reasons against it. Throughout the nineteenth century and up to the present time the controversy 'selection *versus* even-aged systems' has continued; some writers condemning the selection system, other upholding it; at the present day it still has its adherents and its opponents, although the general opinion in most parts of Europe is that it should not be adopted except under special circumstances."

The coppice system, coppice with standards, and the conversion of coppice system are dealt with in separate chapters and the book ends with a chapter dealing with some present day ideas and with the so-called *Dauerwald* which may be translated briefly as "continuous forest" that is forest treated in such a manner that the soil is never exposed. Such a definition covers the selection system but Möller applies the term *Dauerwald* to any system not involving clear cutting. This rather complicates the issue and when *Dauerwald* is further elaborated by its partisans into the negation of system with no rotation, no ideal of the normal forest, nor of the correct distribution of the age classes, nothing but the personal idealism of the forest officer in charge—we must protest that this is bolshevism which in this country could only end in appalling chaos.

The book consists of 192 pages of print and is beautifully illustrated; every forest officer who is interested in his profession should read it and it is an essential work for every working plans officer. It can be obtained from the Oxford University Press, Post Box 31, Bombay, price 21 shillings.

THE GOLD COAST FOREST.

BY T. F. CHIPP.

A study in Synecology, (Obtainable from the Oxford University Press, Post Box 31, Bombay. Price 10 shillings).

The thesis opens with a general account of the Gold Coast Forests after a short section on the history and economic conditions of the country. This is followed by a chapter on the climate, the main feature of which is the decrease in the rainfall

from 88 inches on the west coast to 44 inches inland in the northern territory. There is also a curious decrease in the rainfall on the east coast to 25 inches which is explained as being due to the trend of the coast-line being north eastwards away from the incidence of the South West Monsoon.

The main portion of the thesis discusses the types of vegetation making free use of modern ecological terms. These have fortunately been explained in the introduction otherwise the memoir would have been of little use to the ordinary forest officer who is quite familiar with the conditions described but is apt to be repelled by the language considered essential in modern ecological works.

R. N. P.

EXTRACTS.

PROTECTION OF FORESTS IN THE TRANS-INDUS PORTION OF THE NORTH WEST FRONTIER PROVINCE.

The year under review, with the six months of 1927-28, that have since elapsed, is likely to prove a landmark in the history of forest development in the North West Frontier Province. It is the object of this Administration to initiate measures to check the further denudation of the existing forests in the catchment areas of the Indus and its great western tributaries, in so far as

they lie within political control, and to build up fuel reserves in and around the Peshawar Valley to meet the ever-growing pressure of a dense population on inadequate fuel resources.

As observed by the Chief Conservator the preservation of forest cover in the upper basins of the Indus and its tributaries is not only of vital economic concern to the people, but has intimate reactions on the Peshawar canals, and on the vast Indus irrigation projects of the Punjab and Bombay. For political and other reasons it has not been possible for the problems of forest administration in the trans-Indus terrain to assume a practical shape until the expiry of half a century from the date of the initiation of such measures in the remainder of north western India. The enquiries made during the past few years demonstrate, however, not only the importance of securing control without further delay, but the possibility in certain tracts of obtaining revenue by exploitation or by import duties.

In furtherance of these ends the Inspector-General of Forests visited Peshawar at the invitation of the Chief Commissioner in March 1927. The Inspector-General made short inspections of the area on the Yusafzai Buner border beyond Rustam, where the formation of reserves of *Pinus longifolia* is in contemplation, of the Khairabad depot, of the Cherat-Khwarra tract, and finally of Razmak. As a result of these enquiries, the sanction of the Government of India was obtained to the deputation of Mr. Parnell, Conservator of Forests, for a period of six months. The period of his deputation (May to November 1927) falls outside the scope of this review, but the Chief Commissioner desires to take the opportunity of recording his appreciation of the zeal with which Mr. Parnell devoted himself to this original work, and of the detailed character of his reports. These reports are now receiving the close attention of this Administration with a view to the possibilities of giving practical shape, with the concurrence of the populations affected, to the measures of silviculture and exploitation proposed.

(Extract from the Review of the Forest Administration Report of the North West Frontier Province for 1926-27 by the Chief Commissioner).

GIANT TORTOISE AT THE ZOO.

A NEARLY EXTINCT SPECIES.

A very large land tortoise from Albemarle Islands, in the Galapagos Archipelago, recently deposited at the Zoo by Mr. Clarence Elliott, has been purchased by a member of the Council and presented to the Society. It weighs between 2½ and 3 cwt. and without doubt is the largest living representative of a nearly extinct species. It was found by Mr. Elliott outside a restaurant in Valparaiso, serving as a living advertisement of the place of turtle soup on the daily menu. Mr. Elliott found several smaller land tortoises and several turtles in the back premises, and it is to be hoped that even if the giant had not been rescued it would have had a long life as an advertisement. The Galapagos land tortoises had no enemies in the Galapagos until ships began to visit the group. At one time the tortoises were extremely abundant, and it is estimated that since the 16th century several millions of them have been taken for their oil and as food. Now most of the species are extinct, and notwithstanding strict protection it is doubtful if the few survivors will last long.

Mr. Walter Shakspeare, a Fellow of the Society, has presented a pair of Ceylon Jungle fowl, a species which has not been exhibited in the Gardens for 40 years, and also a pair of the rare Layard's parakeets. The well-known *Gallus bankiva*, or Red Jungle fowl, according to the late Mr. Tegetmeier and other authorities, is the probable origin of domestic game fowl, and is very difficult to distinguish from an ordinary bantam. The Ceylon Jungle fowl has a yellow comb, edged with red, and a red breast.

Layard's parakeet, formerly called Calthrop's, is also a native of Ceylon, and is one of the most beautiful of the ring-necked birds. The head, nape, and back are blue-grey, shading into blue on the rump, the forehead and cheeks are green, and the collar is a broad band of green, edged with blue. The species lives in large flocks in the interior of forests and gorges.

Mrs. Astley has presented a cock and two hens of the North American wild turkey, almost certainly the ancestor of the domestic bird. The name "turkey" appears to have been given

first to the Guinea fowl, but the North American turkey was domesticated in Europe by about 1530. The wild turkey is coppery-bronze, with a purple-green and golden sheen, and extends from the south of Canada to Mexico. The ocellated turkey of Yucatan and British Honduras has an almost black plumage, with tips of green and edges of copper on the individual feathers.—(*The Times.*)

FARMING WITH ELEPHANTS—AN EXPERIMENT IN AFRICA.

(BY TRACY PHILIPPS.)

Although the African elephant is still commonly believed to be untamable, its domestication has for several years been an accomplished fact. Both the original attempt and ultimate success—the reward of admirable persistence through many years—lie to the credit of the Belgians.

The value of the experiment, of course, apart from its interest, lies in the possibilities of the African elephant as a useful servant. The southern Provinces of the Anglo-Egyptian Sudan, the Ubangi-Shari Colony of French Equatoria, and the greater part of the two Uele districts of the Belgian Congo, adjoin each other. These territories form a very large tract of fertile, open undulating country, well watered, with only a relatively sparse and stunted bush. In this area the tsetse fly abounds, and horses and cattle cannot, therefore, live. Yet for colonists, missions, cotton and coffee planters, and agricultural tribes there is a growing need for the plough. It would decrease the menace of famine, increase both quality and quantity of foodstuffs, and release native labour. It is one of the objects of the 25 years of experiment to place at the disposal of tropical agriculture a valuable economic auxiliary. Ploughing by elephant, in local conditions, has proved to be 14 times less costly than the same work done by tractor. There is, incidentally, some possibility that the feat of taming the African elephant has here been repeated rather than originated—this without prejudice to Belgian enterprise. The size of the ear and the slope of the forehead on the elephants depicted on Car-

thaginian coins of the period add weight to the supposition that Hannibal's beasts were of the African breed. Moreover, there seems no reason why in its less arid state the Sahara should not have provided the Carthaginian commander with the source of one of his most effective tactical corps.

In 1879 King Leopold ordered the importation into the Cango, by way of the east coast, of a number of Indian elephants, in the hope that they would prove useful for training purposes. They were unable to face the climate, and, dying, put an end to the experiment. Twenty-one years later the attempt was renewed by Commander Laplume, who captured a baby African elephant, only to find that immature specimens were unsuitable for training, both by reason of their delicacy and by lack of mental response.

AN EXPERIMENTAL FARM.

The work took a more serious form in 1904, when the Belgian Government established an experimental farm at Api, in the Bas-Uele. A skilled white officer with picked native soldiers was placed in charge. In 1906 the elephants were worked regularly for the first time. Local natives of the Niam-niam (Zande) tribe were then introduced as *personnel* to replace the soldiers. About 13 years were thus spent in experiments as to the best methods of capture, feeding, and training. The year 1913, completing a period of 13 years, may thus be said to mark the end of the first continuous period of training of the African elephant in modern times. In the second period, 1914—19, neither credit nor *personnel* were available to carry on the work. The local Political Officer saw to it that the elephants were fed and cared for. Training work remained of necessity at a standstill. The third period began in 1919, when a renewed effort was made to find and develop the natural aptitudes of the elephants and to improve the training. Six *mahouts* were obtained from the Indian Government on liberal terms of pay. They arrived very homesick, and proved to be less resistant to climatic conditions than Europeans. Moreover, they showed little aptitude for the local *lingua franca*, so that their relations with Europeans and natives were not of the easiest. They were soon repatriated to India, with the exception of one little fellow, who was also a skilled ropemaker.

But much had been learned from them. They had taught Burmese elephant songs to the Niam-niam *mahouts*. These songs are still used in working the elephants, but are, without losing their cadence, gradually assuming Niam-niam tunes and, with the enrolment of new *mahouts* who have never heard the Indian songs sung by Indians, Zande words of similar sound are tending to supplant those of the original.

The fourth and present period of development may be said to have started in 1921, when practical results began to appear. The capture of elephants by new and humane methods, designed to cause the fewest possible casualties in a herd, was begun again under the general direction of M. Magnette, assisted by Lieutenant Offermann, of the Guides. A capture-party consists of a European, a detachment of ten well-disciplined native elephant-hunters, and a "group" of about 15 trained Niam-niam youths. The latter group consist of five rifle-men, seven men carrying rope of specified length, and three carriers of tools and rations. The trained elephants remain in readiness in the central camp. The party works usually within a radius of 19 miles, with the camp as centre.

THE HUNTERS' PART.

The party follows spoor, and comes up with a herd, against wind, without giving the alarm. They inspect the herd to see if there are any of the right age. If one is selected, one of the hunters crouches in thick bush where he calculates the herd will pass. He awaits a favourable moment. Sometimes, but not often, the young one can be slightly detached from the main herd. There is a man behind the watcher armed for extreme emergency. The young elephant draws near the ambush. The man runs crouching from his hiding-place and slips a noose-rope round a a back leg or the tail. He then runs back, if possible along the line of the rope, into concealment, now down-wind from the main herd.

The young elephant moves off alarmed. The rest of the party rush to the rope-end, under escort. When the line grows taut the animal probably turns. If he rushes back suddenly a shot is fired over his head. After a struggle he often falls. The

hunter runs up again and places another rope round his neck, securing the other end to the nearest tree. When all are occupied with holding the young animal there is sometimes a rush on them by an old male or a female. The latter is not always his mother, whom he (at such an age) has probably ceased to accompany.

It is in such emergencies only that the rifle is allowed to be used—that is, strictly in defence of human life. In last year's hunts, for 24 captures only one man was a casualty. He had allowed a hostile animal to get too near. The largest elephant captured last year was 1 metre 83 centimetres in height. He was at the time no longer running with his mother, who had two younger ones at foot. When at last the young animal is safely tied up and secured and can definitely be considered a prize, a messenger is despatched to the camp. There the larger trained elephants, known as *moniteurs*, are in readiness.

A pair of these monitors are despatched to the scene. One raises and supports the young elephants, now exhausted. The other monitor stands by to help, and then marches along on the further side, to help or to deal with any return of recalcitrance. It is a curious fact that, on whatever side of the monitor the young animal is attached to leave the scene of capture he will always continue to seek to march on the same side. If ever, by chance, he finds another animal temporarily occupying that side of his monitor, he usually drops behind and seems bewildered. The officer in charge has, therefore, before sending out, to calculate on which side he has a permanent vacancy.

On arrival in camp the young elephant is kept quietly, under the best possible conditions. He is gradually accustomed to the close presence of man and increasingly familiarized with an individual monitor and an individual *mahout*, who feed and nurse him. When the majority of the training-elephants have a small one for each side, towards the end of the dry season the training begins, very quietly but in earnest. No elephant is ever struck. The majority of elephants now employed in work are on an average about 6ft. in height. The Niam-niam, or Zande native provides exceptionally fine material for *mahouts*. He comes of a race whose sport was war, who fought their way

probably from near the Gulf of Guinea, to the equatorial forest. In more settled times elephant-hunting with knife and spear has replaced their sport of war as a national pastime.

In addition to the original school at Api, the Belgian Government has recently established another at Gangara-na-Bodio, near the residence of the Niam-niam chief, Wando, in the district of the Haut-Uele. As I was travelling in the neighbourhood a few months ago I took the opportunity of visiting it. By good fortune Lieutenant Offermann, the manager, was at home, and put his expert knowledge at my disposal.

THE "MONITEURS."

Eight trained *moniteurs* were on parade, placid enough and flipping only an ear here and there as my car came to rest besides them. A little later they, with some of the elder pupils, were dismissed to "pasture." They moved off into the bush, with the *mahouts* seated well forward, free to browse in their own country and to seek out at their leisure whatever succulent morsels they prefer. Thus their feed in captivity is identical with their diet when free in the bush—and it costs nothing. The supply of leaves, herbage, and vegetation generally round the camp is practically inexhaustible. It springs up afresh twice a year after the greater and the lesser rains. The elephants receive each week 50 grammes of salt and a little local cassava. These are simply small delicacies, usually distributed in such a way as to mark the trainer's recognition of special cases of hard work or intelligence.

The *mahouts* looked very smart in their blue jerseys, with the gold star of the Congo emblazoned on the breast. One could not but notice the affectionate relations existing between the men and their beasts, who responded to the soft-toned orders very readily. We walked with the elephants for a short way into the bush and watched them begin to feed. All the animals were noticeably "well groomed." What few sores they had were clean and freshly smeared with antiseptic ointment. Later, in the heat of the day, they would go down to the river for the bath and drink In the cool of the evening, if necessary, they would work again

Leaving the trained elephants we descended the steep bank to the river level. On a shady peninsula, just above water-level

14 "babies," five female, and nine male, were comfortably tethered under shady trees. As we got close in among them they were feeding contentedly. Only those whose capture dated from a few days previously showed any signs of nervousness. Two of them allowed their trunks to be stroked, but showed the greatest aversion to anyone passing behind them. They were tethered with strong, locally made rope, round the neck and round one hind foot. No sores or abrasions were visible as a result of the tethering.

IN CAPTIVITY.

All the young elephants were approximately between the ages of two and ten years. It is only very exceptionally that they are captured over ten. It is, however, extremely difficult to estimate, by height or by size of tusks alone, the age of the young elephant moving with a herd. It is interesting to note the recorded growth in captivity of the elephant named Bama. He was captured in the Bas-Uele on August 2nd 1902. On that day he measured 1 metre 28 centimetres (about 4ft. 2in.) in height. A quarter of a century has now elapsed. He has remained throughout that time in his own district. He is now 2 metres 50 centimetres (about 8ft. 3in.). That is to say, we have here an African elephant which, in his own climate and under natural feeding conditions, has grown 1 metre 22 centimetres in 25 years.

Working on an average from 5 A.M. to 11 A.M., one elephant ploughs 2½ acres of land in two days. The elephant, furthermore, can be, and is, used for other farm work, such as stumping, and for the collecting and piling of timber, as well as for transport in open country, as a feeder to or before construction of roads. Two of the elephants at the farm draw a cart carrying five tons of material. Elephants trained at the two farms are already in use by planters who are working on their own resources and religious missions. Neither of these can afford to make costly experiments or to employ wasteful methods.

Four elephants are employed on the mission cultivations at Buta, two by Mr. de Steenhault de Waerbeke, a planter at Dembea and others on a cotton farm at Bambessa. They are at present on hire. It is calculated that a trained elephant will sell for 60,000f,

The Government training farms should in time become entirely self-supporting.

A SHILLING A DAY.

The cost of maintenance is low. The food of the elephant, as I have said, consists almost entirely of twigs, leaves and roots. Maintenance, including the pay of two men for each elephant, harness and chains, food "extras," ointments, and depreciation, works out at an approximate total of 10f., or slightly over a shilling a day for each elephant.

Lieutenant Offermann, to whom I am much indebted for his courtesy and information, is pressing for an extension of the system of elephant reserves on the same lines as the *Parc national* for gorilla north of Lake Kivu. There is a farm reserve north of his farm at Wando's, but this he regards as inadequate, and with justice, in view of the vast numbers of element shot for ivory and, even more, for food. The Belgian Government are not blind to the importance of the question. By recent legislation no native may shoot an elephant with a modern rifle without purchasing a licence costing 5,000f., a very stiff price to relatively poorly paid chiefs, in the currency of the country.

Nevertheless, it is hard to believe that the elephant can in our generation decrease in numbers in the vast equatorial forest lands of the Congo Basin, where the destructiveness of modern firearms is obviously minimized. In fact, from observations in the Central Congo, one would even venture the opinion that both the elephant and the okapi are probably on the increase.—(*The Times.*)

FOREST FLORA OF SOUTH CENTRAL AFRICA.

Dr. J. Burtt Davy communicated a short paper by Mr. P. J. Greenway on the Forest Flora of South Central Africa, of which the following is an abstract :—

The author of the paper had occasion to identify herbarium specimens of forest-trees sent to the Imperial Forestry Institute from Northern Rhodesia and adjacent areas in the Katanga Province and Nyasaland. The work was done partly at Kew, with the kind permission of the Director.

Much of the material was collected by Mr. R. Bourne, of the Imperial Forestry Institute, while on a tour of inspection on behalf of the Northern Rhodesian Government. The time of year (July to September) was unfavourable for good botanical specimens, very little flowering material being obtainable. The collections represent 131 species, comprised in 80 genera and 34 families. The three families of Leguminosæ furnish the largest number of species; the Cæsalpiniaceæ contain 26, including two new species of *Brachystegia*; Mimosaceæ 9 species, of which five are Acacias; and Papilionaceæ 12 species. In the Myrtaceæ there is a new species of *Syzygium*.

Only two genera, *Monotes* and *Marquesia*, of the Dipterocarpaceæ, are met with in tropical Africa; of the former there are several reputed specimens, which are fairly common in the dry savannah-forest. *Marquesia macroura* Gilg, the "Musesjie," is one of the most abundant trees in Northern Rhodesia and the Katanga, where it attains a height of 65 to 80 feet; the wood is described as very hard and of good quality, and is used for finishing houses and in carriage-building. In view of the great economic interest of the Dipterocarps in the Indo Malayan Region, the African species are worth careful investigation.

Of especial interest is the occurrence of a species of *Hirtella* (Rosaceæ). The genus is chiefly American in its distribution, being represented by about 40 species in Central and South America; no representatives have yet been recorded from West Africa, but two are found in Madagascar, and one is described from East Africa, *H. zanzibarica* Oliver, which was figured in the 'Icones Plantarum' (xii, 81, t. 1193, 1876). To this single species from continental Africa should now be added a new species, and a third species, *H. bangweolensis* (Fries) Greenway, originally described under the name *Parinarium bangweolense* R. F. Fries (in Fedde, Report, xii. p. 540, 1913). Further study of the African material of *Hirtella* in European herbaria is desirable, as it may prove necessary to separate it as representing distinct genus.—(*Linnean Society of London, general meeting 15th March 1928*).

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REGENERATION UNDER THE SHELTERWOOD SYSTEM IN KULU.

The first experiments in the natural regeneration of deodar under a shelterwood in accordance with the technique usually adopted in Europe with Conifers was started in the Kulu division in 1912 and on the orders of Sir George Hart, Inspector-General of Forests, a working plan on these lines was prepared and ultimately came into force in 1919. A period of nearly ten years has, therefore, elapsed and we may now review the results of the system for the benefit of those of our readers interested in the silviculture of Himalayan Conifers with special reference to the deodar. The students of the Forest College have for two years had the privilege of visiting Kulu forests by the courtesy of the Punjab Forest department and it has been possible with this example before their eyes to convince them that the pictures of the text-books exist in fact and are not imagined by learned Professors, who obtain their living by talking about trees instead of growing them. The photos we publish should convince the most sceptical that results equal in every way to anything obtained in Europe are possible in the Himalayas. At the same time we would caution our readers against the adoption of this system without a complete knowledge of the technique necessary to obtain regeneration, not only so far as concerns the technical operations of seed and secondary fellings, but also as regards soil conditions which may be such, even in Kulu, as to result in the complete failure of this system.

We would draw the attention of Punjab Forest Officers to the work carried out by Professor Cajander and his colleagues in Finland into Forest Types. A classification of forest types with reference to their ground flora could, we are sure, be correlated to their capacity for regeneration. Conifers will grow quite well in the *Mercurialis perennis* type of Britain but they will not regenerate themselves and have to be perpetuated by planting.

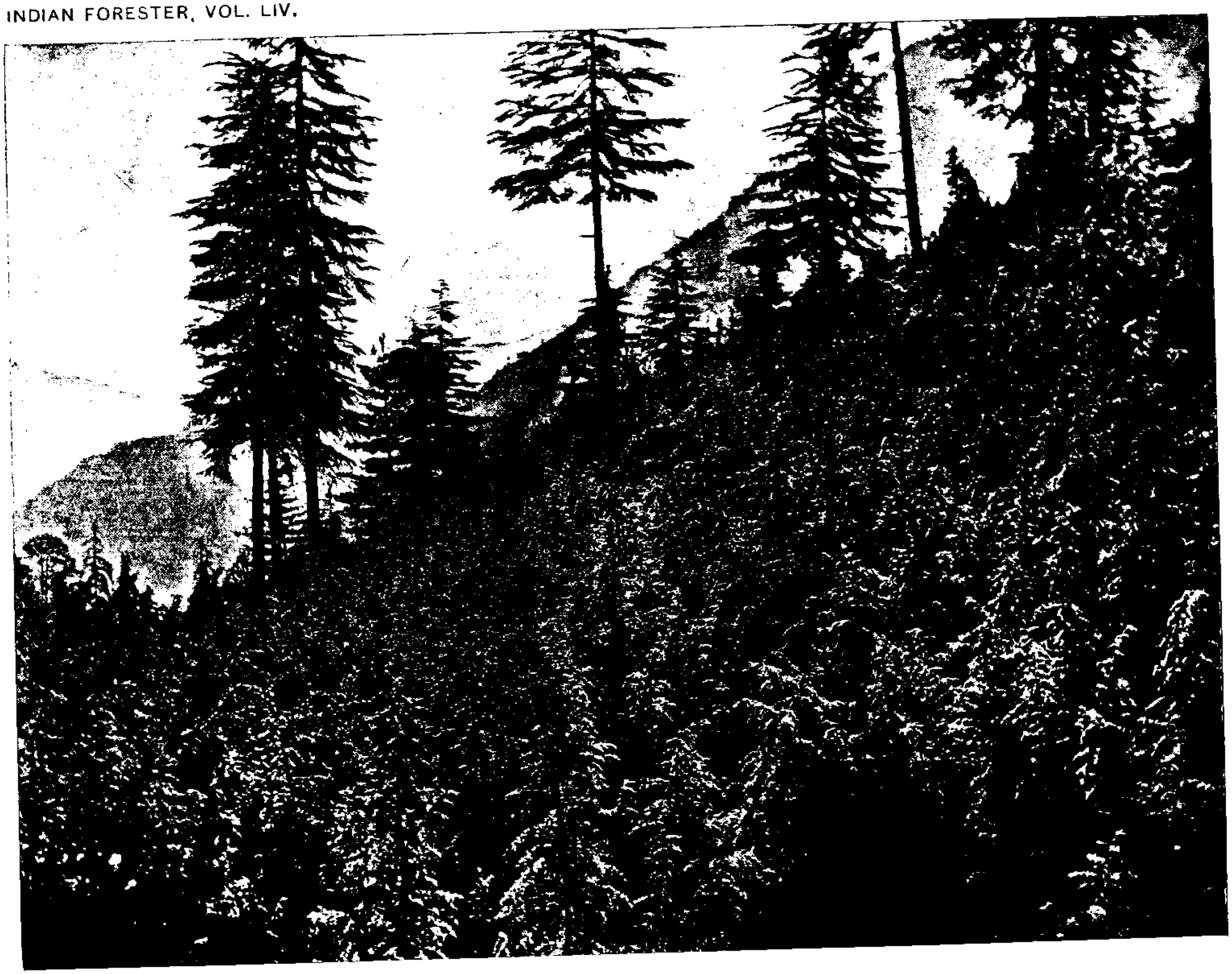
The area completely regenerated in the Regular Working Circle of Kulu is 2,369 acres and 1,988 acres are now in hand, out of a total of 9,624 acres to be regenerated in a period of 25 years.

The principles of natural regeneration as set out in Trowscoed's essay in the "Indian Forester" for October 1921 remain as true to-day as when they were written and there has been little or no departure from the technique originally introduced by the author of the plan.

However there are several points concerning not only Kulu but other divisions which we wish to criticise. In periodic block I of the Regular Working Circle we think the Forest department is too greedy. They seem to have declared war against those useful species the pines both *longifolia* and *excelsa*, for we saw these species being removed where they did not form more than 10 per cent. of the crop and where they were doing no harm. We are more than ever convinced of the superior value of a mixed crop.

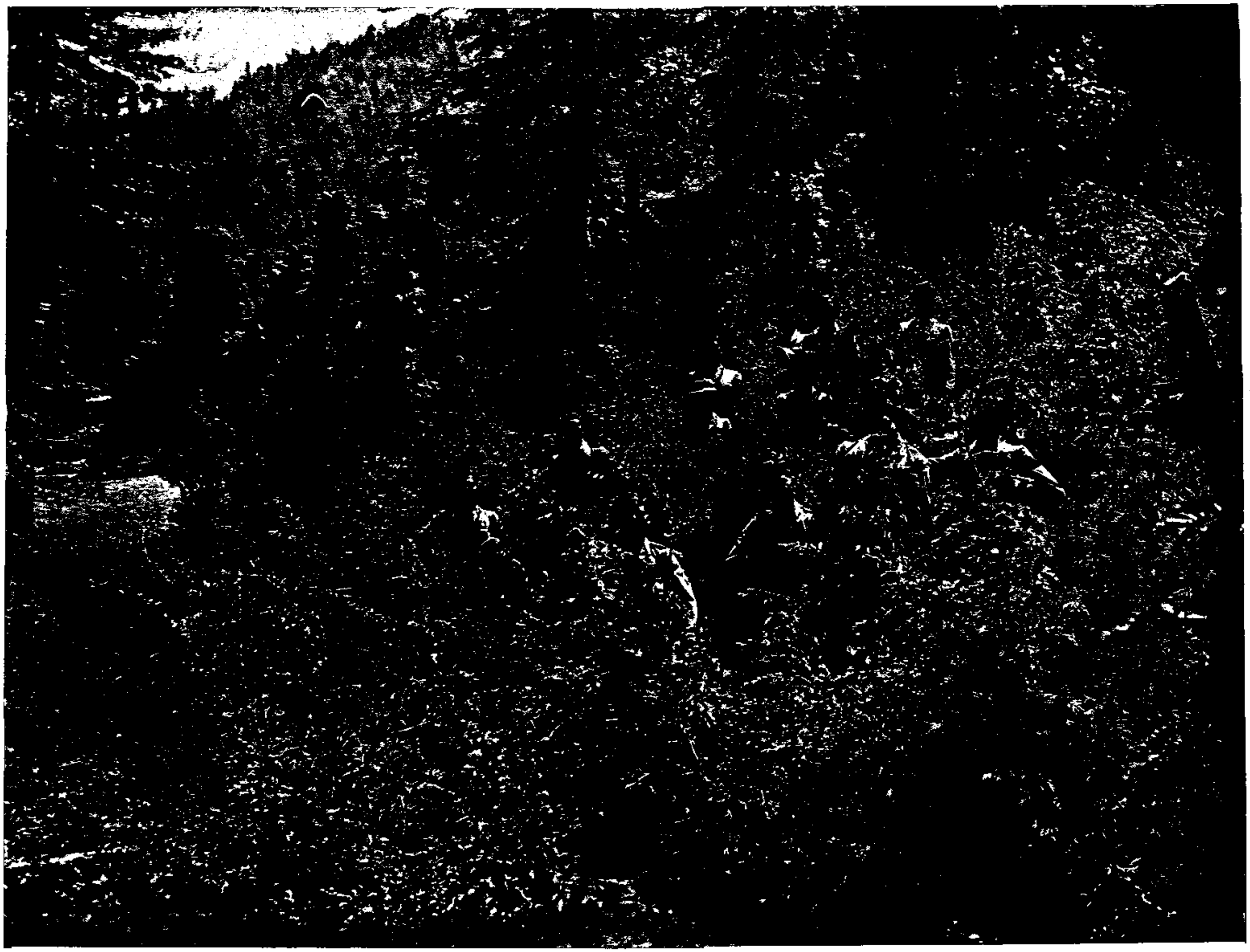
In areas such as Kasol C. I. which are by nature more suitable to chil and kail than to deodar nothing more than a mixture of the latter is required mainly for fire protection purposes and a *mixture of chil with kail is greatly to be desired.* This compartment has experienced a history of terrible fires as can be verified from reading the history of the forest from the old chil stumps showing fires of great magnitude in 1775, 1808, 1833, 1855 and 1913

We were present at the last fire which ruined the greater part of C. I. A mixture of chir and deodar is of much value, the former for its fire resistant qualities and the latter because it cleans the ground and renders the crop less inflammable. Incidentally the kail is growing twice as fast as the deodar putting on leading shoots 3 feet long and from a financial point of view is

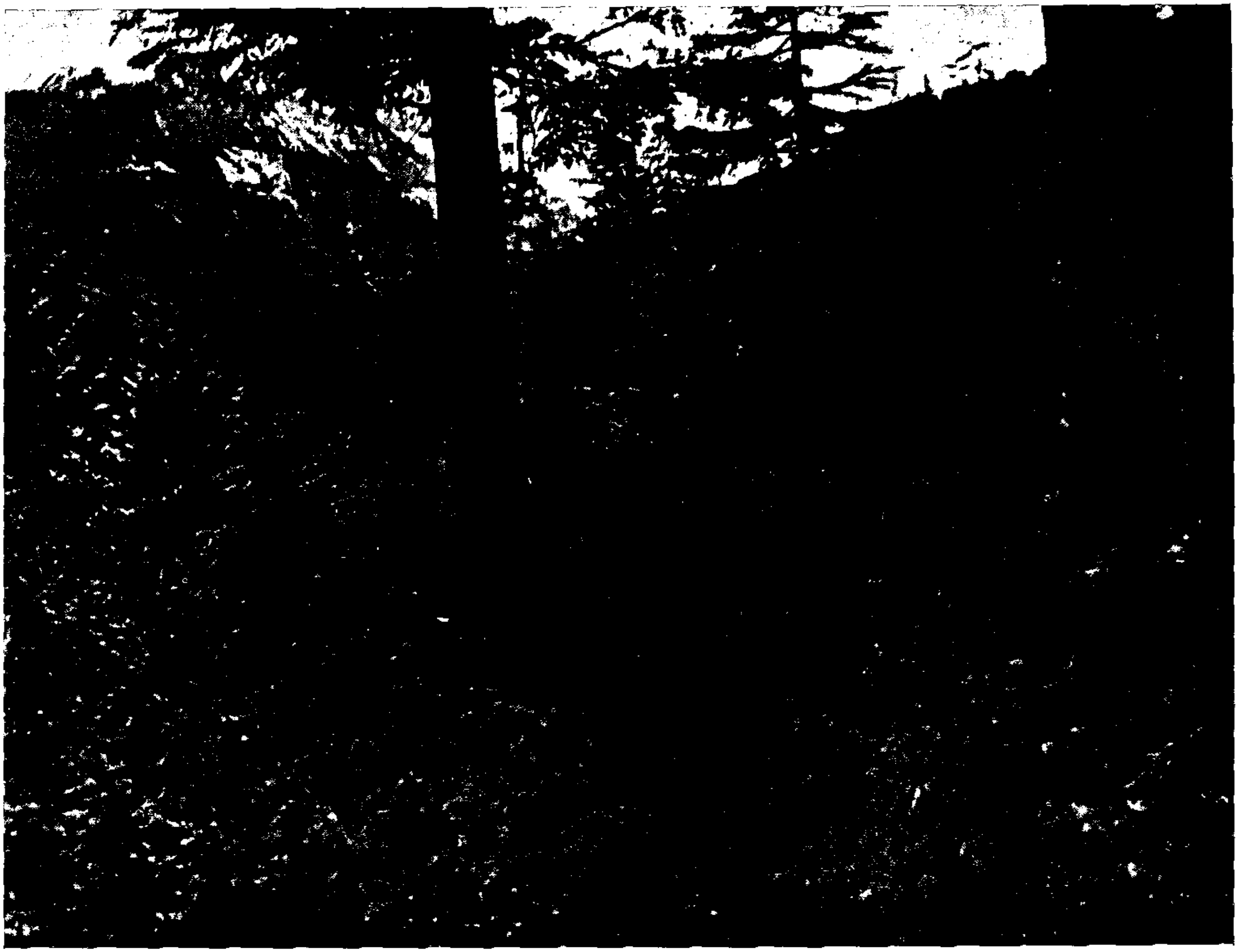


The results of the seeding felling of 1918.

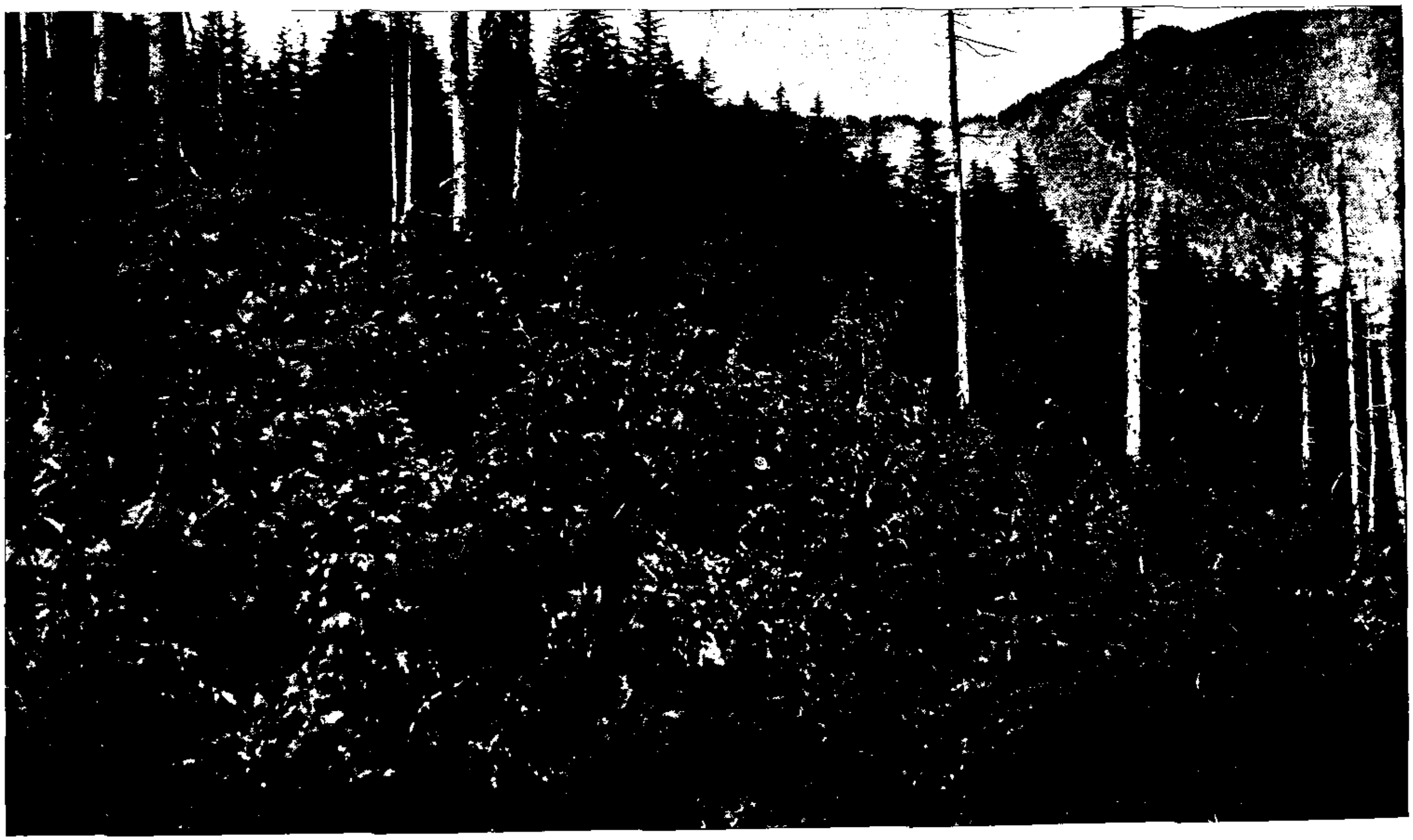
Start Sept Photo



Natural regeneration of deodar. Final felling made.



Regeneration in groups. Overwood marked for felling.



KAILIBAN 1/16. C.I.
The amalgamation of new regeneration with the retained deodar pole crop.
April 1928.

probably to be preferred to deodar, if it was not for the fire hazard.

In the case of the high lying mixed kail and fir forests we are certain from what we have seen in Central Europe and from the evidence now obtained in Nakas and Kalga that it is the excessive deposit of humus on these cold and high lying sites which has prevented natural regeneration. It is remarkable that wherever a tree has been blown down, young kail will frequently be found coming up on the mineral soil turned up by the roots, and when the forests has been destroyed by an avalanche young growth springs up either straight away or following birch or poplar very much in the same way as happens in Northern Canada after a fire.

We consider there is a tendency to overdo the cleanings and by cleanings we mean the thinning of young saplings. There can be no use in thinning out saplings whose branches are still green down to the ground and this operation is much better deferred to a later date. The great criticism of the regeneration work is the low standard of nursery management. To any one acquainted with the nursery work of the Forestry Commission in Great Britain or the extensive and beautifully equipped nurseries of the Forest department of Quebec or Ontario, the Kulu nurseries are not impressive. They are most inadequate in size, the germination per cent. is low and the number of plants per pound of seed and per square yard of nursery bed insufficient. It is quite time the standard of nursery work in Kulu was brought into line with the general excellence of the regeneration work; more especially so when the remedy for the failure of regeneration in the kail-fir type of forest appears to be the planting of good sized nursery plants of kail. We hope to see in the near future nurseries which can consistently produce 50,000 plants a year at a reasonable cost.

As regards work outside periodic block No. I we have noticed tendencies by no means only confined to Kulu or the Punjab but common throughout India and that is to abuse the latitude allowed to the executive officer to remove trees in supplementary fellings or so called improvement fellings. In this case the working plan definitely stated that supplementary fellings were usually not necessary and would not be made. This did not prevent the

carrying out of such fellings, not with any silvicultural object in view but merely in order to increase revenue. Such fellings are deliberately harmful and should be suppressed. In a paper which we have before us, which has been prepared for the next Silvicultural Conference, and which will be later published in these pages it is stated :—

"We must further definitely design our marking rules for the Intermediate Periodic Blocks, so that while the hands of the executive officer are not unduly tied in respect to the application of silviculture, there shall be no risk that the stock of revenue producing trees in these Periodic Blocks is depleted on the grounds that 'they are moribund or likely to deteriorate' before the plan is revised. The marking rules should be definite on this point, so that the executive officer realises the importance of removing large sized stems only on definite silvicultural grounds. The executive officer has a very clear duty in seeing that the whole of the yield regulation does not fall to pieces in this manner and should be held responsible if at a revision of the plan no areas are to be found fit for a P. B. I., either from a silvicultural or revenue producing point of view."

We are glad that this error has already been observed and corrected by the Chief Conservator but it is an error only too common in India, an error which ultimately leads to disaster when at subsequent revisions it is found that no area is fit for regeneration in a new periodic block No. 1.

The object of all fellings outside P. B. I. should be to maintain full stocking and a reasonable evenagedness in the crop ; not to cut it up and make it more unevenaged by so-called improvement fellings (a blessed name only too often the refuge of the incompetent) ; and not to remove any tree the felling of which will decrease the average maturity of the crop or encourage advance regeneration. These areas have to be nursed to *average* maturity at the earliest date and no fellings which decrease *average* maturity should be allowed.

If every 24" tree is cut out as soon as found the result will be that at the end of the first period no area of mature crops will be forthcoming ; the Forest department will have eaten its

cake, leaving only a few miserable crumbs to pay for the salaries of the next rotation of forest officers. This is not imagination; it has already happened in one division in India and we assisted in the appalling row which resulted when the true facts of the case were duly exposed.

It is a more pleasant duty to turn to the pictures which illustrate this article and which display a perfection of regeneration of which the Punjab may well be proud. These pictures have been shown to one of the leading lights of the profession in Central Europe who remarked that he had seen nothing finer in the whole course of his experience. Plate 35 shows natural regeneration of deodar resulting from the seeding felling of October 1918 at which time the seed from which the regeneration springs was on the trees. Plate 36 shows the Forest College embowered in young deodar from which the overwood has been finally removed. Plate 37 shows all stages of regeneration arranged more or less in groups and ready for the final felling, and Plate 38 shows the amalgamation of new regeneration with the pole crop retained as part of the future crop.

We will conclude this article by expressing our gratitude to those Punjab Forest Officers through whose kindness the students of the Forest College were able to see this work; for ourselves we have been permitted to revisit the forests amidst which the happiest years of our life were passed; to see the results of nearly 20 years of work. Truly the promise has been fulfilled :—

"Instead of the thorn *has* come up the fir tree
Instead of the briar *has* come up the myrtle tree."

FORESTS AS A TRANSFERRED SUBJECT.

We notice that there are fifteen vacancies in the Bombay Forest department and we have not heard that any measures are being taken for recruitment to fill these vacancies. No forests can be protected in India without adequate supervising staff and it is interesting to read the paragraph called "Protection of Forests" in the Bombay Forest Administration Report for 1926-27. The title of the paragraph appears to be unsuitable. The

Chief Conservator estimates that damage to the extent of Rs. 29 lakhs was done during the year by people who committed forest offences. He estimates that one in every five grazing offences and that one in every ten felling offences was reported. The damage is done mainly by villagers who live near the forests and who enjoy grants in the forests valued at Rs. 10 lakhs annually. It is no exaggeration to state that in some places the forests are in a grave danger of disappearing. Communal punishment, the only effective means of dealing with wholesale looting, has recently been withheld by Government. The following paragraph may be quoted in full :—

"It will be seen from the increase in offences under unauthorized felling and grazing that the efficient protection of the forests is becoming more and more difficult. In this connection local agitators do a great deal of harm. The Bombay presidency forests form about 15 per cent. only of the total land area, and even if intensively worked and excellently protected are too small to ever satisfy the full demand for timber, fuel aud minor produce. The more they are abused, therefore, the more the necessity for imports and the greater the loss to the country."

This leads us to ask what is going to happen to the Bombay forests under democracy?. It is inevitable that the people who now misuse the forests will clamour more and more for rights to misuse them still further. Will any Government depending on votes be strong enough to resist such clamour?. Or are the forests to which several generations of forest officers have devoted their lives already doomed to a slow and painful extinction? Perhaps some of the Bombay politicians will supply the answer.

THE DISTRIBUTION OF SAL AND BAMBOOS IN SOUTH PALAMAU DIVISION, BIHAR AND ORISA.

"Edaphic" factors control the distribution of sal and bamboos in Palamau division. (I have always hated the word "edaphic," which specialists have made their own, as connoting soil conditions, and am still haunted by memories of Greek irregular verbs which convince me that it has something to do with feasting).

The governing factor is really geology.

The bamboos (*Dendrocalamus strictus*) grow on the Bengal or Dome gneiss and its detritus, and the sal on the laterite and iron ore beds, which overly the Dome gneiss.

The Dome gneiss forms the characteristic dome-shaped hills which distinguish the eastern boundary of the Bengal plain, and are so conspicuous on the Railway journey from Purulia to Ranchi, and owes its name to the shape of these hills ; it underlies the laterite of the Ranchi and Netarhat plateaux and the spur of the latter thrust north into Palamau district.

The component minerals are the usual ones, which form granite, gneiss and other igneous rocks, mica, quartz and felspar, but the tension caused by the folding, which gives the hills their characteristic dome shape, causes it to weather in a peculiar manner. Superficially there does not appear to be any reason, why it should weather at all under the mechanical action of rain, but chemical decomposition of the felspar under the action of rain causes it to exfoliate in large curved sheets, which fall down and form the detritus, which with time on some aspects has risen up towards the top of the dome. The mother rock is, however, generally visible in the beds of streams and on the steeper aspects, it rings hollow to the foot, which shows that the detachment of the outer sheets is still going on.

The gneiss is overlaid unconformably by beds of iron ore and laterite gravel, and even on the top of these beds at Netarhat, the ground again rings hollow under foot, showing that the underlying gneiss is decomposing under the action of rain, which easily penetrates the gravel and the largely vesicular iron ore beds, which cover it. The junction of the two rocks, as of that of the flora, which they support, is sharply defined and is often marked by perennial springs, generally in the re-entrants of the contours and also sometimes on the barest and most precipitous aspects, as on the western face of the massif, called Datron, which overlooks Marumand forest bungalow. The line of the junction may also be marked by stag-headed, dying and dead sal trees. This would seem to be due to the fact that the beds of the laterite and iron ore have thinned out at the point of junction and the roots of

the sal are unable to penetrate the smooth surface of the gneiss, while the heating up of the adjoining exposed surfaces of gneiss rock in April and May evaporates much of the moisture that is required by the sal at the season, when this tree must call on its deep root system for moisture to effect the flush of the new leaf.

The detritus of the exfoliated sheets of gneiss forms the soil which is favoured by the bamboos almost to the exclusion of any other species on all the steeper slopes, except on the very hottest and most exposed aspects, which favour *Euphorbia Nivulia* and along the steeper stream beds where *Bridelia retusa* is characteristic.

Gneiss is a rock, which yields on decomposition a fairly good soil, containing clay from the felspar aerated by the sand grains from the quartz.

Lying as it does on steep slopes, where the underlying rock is mechanically nearly impervious to root penetration, it forms an ideal medium for bamboo growth, in as much as during the monsoon this same mechanically impermeable underlying rock also prevents the rains running off the hills from soaking in, and the surface soil is kept in a state of practically continuous saturation. The rain-fall on the higher slopes is probably between 60 and 70 inches a year and these slopes carry the purest forest of bamboo (*Dendrocalamus strictus*) that I have ever seen.

The laterite and iron ore cap on the top of the gneiss carry a sal forest of stunted third and fourth quality poles, of indifferent growth, and most of the older trees are stag-headed if not hollow. The reason for its poor quality would appear to be, that there is too much iron and too little soil. The creeper *Bauhinia Vahlii* joins the sal in forming a vegetative covering for the iron ore and laterite; on some ridges the combination of these two species is nearly impenetrable.

Below the Bamboo belt this detritus of gneissic sheets spreads out, as the slope moderates, forming a talus near the larger streams, where pockets of deeper soil occur, and, since it may almost be assumed, that iron is an essential component of sal forest soils, and since sal is found in isolated patches in this talus,

we must conclude, that iron in solution has passed through the soil of the bamboo belt without deposition and only combined where the abrupt drainage is interrupted by pockets of deeper soil. There must be some critical slope, on which iron will be deposited so that, if the angle of drainage exceeds this slope, the iron will pass on until it finds a gentler slope and deeper soil, with which it can combine.

The occurrence of sal in the belt of submontane debris is very capricious, but the growth is good, much better than on the laterite cap on top of the gneiss, in places the sal forms a belt at the foot of the hills surrounding the extensive blanks, old village sites which are all that remain of, what may once, before cultivation and terracing, have been with natural drainage good areas of valley type sal forest. The sal shows no tendency to re-invade these old-rice fields, which remain unaltered fifty years after reservation and are the cold weather grazing grounds of bison. And since frost is emphatically an influence, which must be reckoned with, if the artificial restocking of these areas is ever to be attempted, it is probable that the *khair* (*Acacia Catechu*) may have to be used as a nurse in such areas. It is possible that the completion of the Central India Coal Fields Railway may render the afforestation of these areas a proposition, which the Local Government may consider remunerative, but hitherto communications during the monsoon have been of such a doubtful nature that all experiments in this direction, if ever made, have lacked effective supervision ; the completion of the bridges over the Auranga and the Koel rivers with the possible metalling of the road will bring these forests within a 20 to 25 mile radius of railway stations.

The bamboos are at present unexploitable, a restricted floating season, September-January, plus a rapid on the Koel river at Kutku, about 2 miles long, having hitherto defeated attempts at water transport by local labour. This is not an obstacle which would hold up any firm, that meant business. From Government forests probably 10 lakhs of bamboos could be exploited annually, while the total could probably be doubled by negotiation with adjoining Zamindars.

If a small Paper Pulp Mill were located on a railway siding near the Koel river, between Kechki and Barwadih stations, the site would have the following advantages:—the mill would adjoin the Koel for water supply, be 5 miles from Barwadih for coal, and could get lime from the Rohtas Lime Company at Jopla.

J. H. LYALL, I.F.S.

Dated 1st June 1928.

BOX TESTING AT DEHRA DUN.

Box testing, like all other testing, has its importance in the sphere of commercial research, as it helps in the study of the construction of the container that best suits a particular purpose. It also determines the relative ability of different styles and sizes of boxes to stand rough usage, and furnishes valuable data in selecting timbers likely to prove suitable for box construction.

Among other things, the properties one looks for in materials for the construction of boxes and crates are :—

(1) Its availability and cost.

(2) Its weight.

(3) Its seasoning properties.

(4) Its working qualities.

(5) Its strength.

Material for containers must be easily available, should be comparatively cheap and should have moderate strength for weight. To business men with a large import and export business the weight of containers often forms a very important consideration, as they do not want to pay more frieght for the transportation of their merchandise than they can possibly help. But, at the same time, they expect the container to be sufficiently strong to be able to stand rough handling in transit.

Timber for boxes and crates should season fairly easily and should not have a very high shrinkage factor, so that the planks

do not warp or check badly with variations of temperature. It should also be a good nail holder and should preferably not be a splitter.

Now the best way of testing these properties in box shocks would be to have some boxes made up out of the material under investigation, and to let them undergo trials in the various stages of commercial service. But, as it is very difficult to get complete data regarding the time of service, and the cause and nature of failure under such circumstances, and as these service tests would take a considerable length of time, some laboratory tests which closely simulate the hazards encountered in commercial transportation have been invented, and a commercial box testing machine, as used in the United States of America, has been devised to give the boxes a "service trial" in the laboratory. Such a machine has lately been erected at the Forest Research Institute at Dehra Dun. The "service" tests as done in the laboratory comprise—(1) Drum Box Test, (2) Drop Test, and (3) Diagonal End Compression Test.

Drum Box Test.—The machine for this test consists mainly of a hexagonal drum with different types of hazards fixed on the six internal faces. The box to be tested is packed with material of the same weight as it is supposed to contain in practice, and is placed inside the drum which is then made to run slowly. As the drum revolves, the box slides about and falls from one face to another striking against the hazards on the way. The box in this way is subjected to very rough use such as is usually met with in practice. The test is continued till the box gives way in some place and is considered unfit for further use. The number of "drops" needed to cause this failure is read off directly from a counter attached to the driving shaft of the drum. This number differs for different boxes but directly indicates their relative strength and suitability.

Drop Test.—In this test, the box, with its contents, is suspended by each of its corners alternately, and is dropped upon a cast iron plate from a fixed height, till it breaks. The number of drops causing failure is then recorded.

Diagonal End Compression Test.—In this test, the box is compressed in a testing machine along two diagonally opposite edges until it breaks. The load required to cause this failure is then noted.

The drop test measures only the shock resisting ability of the box and the compression test measures the ability of the box to resist collapse, but neither is so good as the drum box test for drawing conclusions as to possible improvements for the box in question.

The above is a very short description of one little known item of the research work now being undertaken at the Forest Research Institute at Dehra Dun. As box testing is a matter which has received little attention in India in the past, it was thought that it might interest readers of the "Indian Forester" to know that Dehra Dun is abreast of the times in this respect, and should any reader have a portmenteau or a suitcase which they are not quite sure about, Dehra Dun will be pleased to oblige by testing it under modern methods. The authorities do not, however, undertake to supply new trunks in return!

R. K. BANERJEA,
Assistant, Timber Testing Section,
Forest Research Institute, Dehra Dun.

DEHRA DUN:
Dated 7th June 1928.

BARK OF HOPEA PARVIFLORA AS A TANNING MATERIAL.

By K. S. Choudary, E. Yoganandam and N. Arokianathan,
Research Laboratory, Leather Trades Institute,
Madras.

Hopea parviflora.—" Iron wood " of Malabar is a very large handsome evergreen tree generally found in the moist evergreen forests of the Ghats. The wood is hard and is an excellent timber much prized locally.

Two samples of the bark received from the Divisional Forest Officer, South Mangalore, through the Deputy Forest Utilisation Officer, Madras, were analysed according to the official method of the International Society of Leather Trades Chemists with the following results—(Table I).

(TABLE I).

	SAMPLE I.		SAMPLE II.	
	As received.	Moisture free.	As received.	Moisture free.
Moisture	8·6	...	8·3	...
Insolubles	59·6	65·2	6·6	66·0
Non-Tannins ...	6·0	6·6	7·2	7·8
Tannins	25·8	28·2	24·1	26·2
Tintometer Reading—(Solutions containing 0·5% of the material were used and readings were taken in ½ cm. cell).	...	...	..	...
Red ...	5·1	...	4·6	...
Yellow ...	9·6	...	9·9	...

The tannin belongs to the catechol class giving the usual qualitative re-actions. The bark is fairly rich in tannin content.

Next to wattle, myrobalans and divi-divi it is the richest of the South Indian tanning materials—(Table II).

TABLE II.

Material.	Tannin Content (calculated to 10% moisture.
WATTLE. (Acacia decurrens).	35·7
DIVI DIVI. (Caesalpinia coriaria).	33·6
MYROBALANS. (Terminalia Chebula).	27·0
IRON WOOD. (Hopea parviflora).	25·4
AVARAM. (Cassia auriculata).	16·6
KONNAN. (Cassia Fistula).	11·2
BABUL. (Acacia arabica).	8·0

The amount of non-tannins is rather low. The amount of tannins is five times that of the non-tannins. This high proportion of tannins to non-tannins renders the material suitable for the preparation of extracts. It has been possible to prepare a

a solid extract containing as much as 66% of tannin. In Table III are given the analyses of a liquid and solid extract prepared in the laboratory :—

TABLE III.

	Liquid extract.	Solid extract.
	per cent.	per cent.
Tannins	44·2	65·9
Non-tannins	13·8	21·6
Insolubles	2·5	2·6
Moisture	39·5	9·9
Colour—(Solutions containing 0·5% of the material were used and readings were taken in ½ cm. cell.)	...	...
Red ..	2·6	3·9
Yellow ..	4·5	8·9

Liquors prepared from this bark undergo little fermentative losses as compared with liquors from divi-divi and myrobalans. The leather produced from the bark is of a fairly light shade but slightly more brown than is required for the South Indian export trade.

SOME TREES OF RECORD GIRTH IN KASHMIR.

The salubrious climate of Kashmir provides almost ideal conditions for the growth of both trees and men. During my peregrinations in the Happy Valley and in the adjoining Jammu Province, I have come across several trees of large girth, and some of them of what appears to be a record girth. A few of these latter trees are described in this brief note,

Strange though it may appear, it must be mentioned that these trees of large girth are not very common in the forest itself. The reason for this is not far to seek. The Kashmir forests have always had a good reputation for quality and marketability. They, therefore, came very early under the axe with the result that many, though not all, trees of goodly dimensions are gone. Nevertheless, in out-of-the-way places, there are still some magnificent deodar trees of 20 feet girth and over. The deodar trees of extraordinary dimensions occur either in these forlorn cut-off patches of forest or around deodar *banis* or forest temples. The largest tree that I came across measured 38′-9″ in girth; it occurs in the Mohu-Mangat forest, Banihal, in the Jammu province. It is situated on a precipice overlooking a *nala* which peculiar situation is apparently responsible for its safety. The tree is quite healthy and would probably have been of much greater girth than it is, were the soil not so rocky. Other veteran trees of girths varying between 20-30′ are found rounddifferent deodar *banis*. Sir Peter Clutterbuck in his note on the Kashmir forests describes a tree in Muzaffarabad which in 1924 fellings "yielded 340 sleepers of 3 cubic feet each which is probably a record."

Next to deodar, it is the spruce (*Picea Morinda*) which attains very large proportions. One of the reasons why it outlives the associated fir is its comparatively hard timber which does not yield easily to the strokes of the axemen. It is, therefore, generally noted that in the fir coupes, the contractors let the spruce trees remain standing. In one of such coupes in the Ramban forests, Jammu province, I measured in June a tree 24′-8″ in girth which is very healthy and with no outward signs of senility.

The broad-leaved trees found in or outside the forest prosper just as well as the conifers. The Kashmir valley is properly speaking a valley of *chenars* (*Platanus orientalis*) and poplars. Were it not for these stately trees, the valley would not be half as charming as it is. Mr. J. C. McDonnell has already communicated girths of certain *chenars* which in 1903 were 43′ and 50′ at Jahama and Drugmula respectively. The most famous of all the Kashmir *chenars* is the one at Bijbehara near Srinagar which measures 54′ at ground level, 41′ at breast height, and 46′ at two-feet height

from the ground. The folklore has it that this tree was planted by Jehangir. There were two *chenar* gardens, one on either side of the Jhelum river spanned by a bridge. The garden on this side of the river was meant for men, the opposite one being reserved for the Emperor's harem. The Nasim Bagh planted by Jehangir in 1,635 A. D had 1200 *chenar* trees.

The Verinag spring which is the source of the Jhelum river, and which spring was likewise ornamented by Jehangir in 1612 A. D., though finished by his successor, has in its courtyard two poplars of extraordinary dimensions. In June 1927, I measured the girths of these poplars (*Populus nigra* var. *Pyramidalis*) to be 13′—1″ and 14′—9″. These trees are rather closely planted and touch each other. The first impression of the visitor to the spring is that his movements are being closely watched by these vigilant sentinels standing shoulder to shoulder, sentinels who would not brook the pollution of these holy waters !

The poplar occurs in great abundance in Kashmir, but is only rarely found in the sister province of Jammu. On the other hand in wet cool places, it is the alder (*Alnus nitida*) which is so frequent that it is sometimes called "the Kishtwar tree." In the Udil Valley of Kishtwar, there are many big alder trees of girths varying in size from 8′—15′ and one 15′—10″ which is probably a record.

In some of the *ziarats* or village shrines, there are elm trees (*Ulmus Wallichiana*) which are also considered holy. In the Duligam *ziarat*, near the Banihal cart road leading to Kashmir there is a healthy elm which in last March was measured to be 28′—2″. In April last, I measured a green elm in Bhadarwah Valley which was 39′—10″ in girth, but it was hollow.

Out of the exceptional broad-leaved forest trees, I came across in 1925 a *kharsu* (*Quercus semecarpifolia*) in the Mohu-Mangat forest, Banihal, which was 22′—8″ in girth at breast height and which was a tall healthy tree with a clean bole for over 50′ and which promised to live another century.

These are but a few of the many extraordinary trees found in Kashmir; there may be many others in out-of-the-way places which may out-Kashmir the Kashmir records. Yet, they go a long way to show that Kashmir is not only a Valley of lilies and

lakes but of magnificent forests with not a few hoary-headed veterans!

RAMBAN: SHER SINGH, M.Sc.,
18th June 1928. *Kashmir Forest Service.*

[A list of large Himalayan trees from the records of the Forest Research Institute is given below :—

Deodar.

Kulu, Dhungri temple	...	204′ height, 17′—4″ girth.
Kashmir ...	...	210′ height, 21′ girth.
Bushahr ...	...	150′ height, 31′—6″ girth (at 6′).
Sutlej Valley	...	240′ height.

Pinus longifolia.

Tons Valley	...	180′ height, 10′ girth.
„ ...	...	178′ height, 11′—3″ girth.
Hazara ...	...	150′ height, 7′—3″ girth.
Almora ...	...	115′ height, 12′ girth. [154′ maximum height, 12′—7″ maximum girth, C. Almora.]

Abies.

Jaunsar ...	...	206′ height, 18′—9″ girth.
„ ...	...	202′ height, 26′ girth.

Picea

Jaunsar ...	...	215′ height, 19′ girth.
„ ...	...	202′ height, 23′-10″ girth.

Pinus excelsa.

Kashmir ...	...	165′ height, 9′ girth.
Hazara ...	...	110′ height, 12′—4″ girth.
„ ...	...	150′ height. (sample plot, average height 138′).
Kulu ...	...	125′ height, 10′—10″ girth. ED].

NOTE ON A POSSIBLE NURSE FOR SAL

During the course of my tours last winter I was camped at a forest village of the Dindori range where I was struck by the dense growth of *Trema orientalis* on an old deserted "khandan." (A

"khandan" is a clearing made by Baigas, who go in for shifting cultivation, in which they sow sweet potatoes). This species I found had established a dense stand in this area which was low lying and frosty. There was a good deal of sal regeneration about which in the vicinity of this species had pushed ahead and established itself. The contrast was most marked at some distance where the sal regeneration was not protected. I found the field had been abandoned for 5 years and on cutting down a tree verified this from the rings. The tree is an extraordinarily fast grower, in this case over 20′ high with a large and heavy crown.

Frosts are severe in this division and constitute a factor of importance in the regeneration of sal. I am now going to sow up some frost areas under regeneration with *Trema orientalis* to see if it will do what I expect, and as this is a question of possible interest to other Forest Officers I make the suggestion for what it is worth; my one regret is that I had no camera to illustrate what I saw.

D. C. McDONALD, P.F.S.

D. F. O., South Mandla Division, C. P.

TUBERCULOSIS IN AN ELEPHANT.

Elephant Sultan belonged to the Coorg Forest department. He was captured on 21st March 1903 in a pit. He was a mukna, aged 32 years, 7 ft. 7 inches high at the time of destruction. He was a well made and strong elephant perhaps the best all round worker of all the departmental elephants. He was usually employed on dragging logs and in elephant capturing operations. I have been his doctor and surgeon for the last 16 years examining him every few months. He was always in good condition and good tempered. He used to suffer occasionally from spasmodic colic. During the first attack in 1914 he was off his feed and water for 5 days. The subsequent attacks lasted only for a day or two. In 1918 he once slipped from a height of 50 feet, rolled down and fell at the base of the Ghat. He remained in the recumbent position for over 24 hours, got better in three days and went to work after a week. He

developed an abscess at the withers in 1925. It was opened giving free drainage. The wound refused to heal for about two years, though he was not harnessed and was well attended to. I went on leave and saw him again after two and a half months on 16th August 1927 He was harnessed and going for work. He appeared unwell. I examined him. His eyes appeared to indicate indisposition. His temperature was normal 97·4F. I had him walked fast for about 100 yards, his breathing was rather deeper than normal but not hurried. I then rode him for about two miles and found a clear disinclination for movement and the breathing was marked, though the change could not be perceived by the Chief Forest Officer. I could not hear any abnormal sounds from the lungs. The elephant was in good condition. As I had previous experience of a case of tuberculosis in an elephant in 1926, I suspected Sultan of tuberculosis. I could not obtain a sample of sputum then. He was put under a course of cod liver oil and segregated.

He was subjected to tuberculine test on 2nd September 1927. There was no rise of temperature during the whole day. The next morning *i. e.*, after 24 hours it rose to 99·4F and the animal showed febrile symptoms with profuse running from the eyes. At the 48th hour the temperature was 97·6F.

The Director of the Imperial Institute of Veterinary Research thought the reaction to be doubtful positive and advised retesting after two months.

On 18th November 1927 the elephant was subjected to the test again. There was no rise in the temperature at all this time. As the animal appeared dull in his ways and both the inspiration and expiration were deep if the animal was walked a few yards, I reported to the Director that it was probably due to the advanced stage of the disease that there was no reaction.

On 16th November 1927 I sent sputum smears to the Principal, Madras Veterinary College and to the Director of the Imperial Institute. Both found acid fast bacilli indistinguishable from tubercle bacilli and the Director, Imperial Institute of Veterinary Research, advised destruction of the elephant as he thought it was highly suspicious.

POST-MORTEM NOTES ON THE BODY OF ELEPHANT SULTAN.

The elephant was shot at 8-30 A.M., on 8th February 1928 and the post-mortem examination commenced immediately by Mr. C. B. Somanna, G.M.V.C., and myself and ended at 1 P.M. The animal fell dead on the right side without a struggle.

External appearances.—The animal was in very good condition. There was a little running from the eyes. All the natural orifices were normal. The skin was normal both to the touch and sight. The mucous membrane was rosy.

The skin was cut along the line of the back from the withers to the root of the tail and behind the shoulder and along the flank down to the median raphe. The skin was then flapped out. The subcutaneous tissue was normal and lined with fat. The abdominal and intercostal muscles were normal and covered with fat.

The ribs at the part were severed at their heads along the side of the spinal column and flapped out with the abdominal muscles. The peritoneum was a sheet of fat resembling that of a fat sheep and the pleura was slightly thickened. The abdominal cavity contained a few pints of normal fluid.

Stomach and Intestines.—The intestines were pulled out along with the stomach, spleen and liver. The mesentery was full of fat. On cutting open the mesenteric glands, fine hard granules were seen (a few glands have been sent to the Principal, Madras Veterinary College, for examination.)

The external walls of the stomach and intestines presented a normal appearance. The stomach and intestines were slit open throughout. The contents were normal. The wall of the large intestines contained scattered and at places matted nodules containing thick caseous matter. (These have been collected and sent to the Principal.)

Liver and Pancreas.—These were normal in size and appearance (a portion has been sent). Bile was normal.

Spleen.—The superficial vessels were slightly engorged and the pulp congested. There were a few fine *hard* granular *white* nodules scattered about on the margin as big as mustard seeds (a piece with such granules has been sent).

Kidneys.—They were normal and coated with a thick layer of fat. The bladder was normal.

Testicles.—These were normal.

The Diaphragm was normal.

Thoracic Cavity.—The thoracic fluid was about a pint mixed with blood as a vessel had been cut during post-mortem examination.

The pleura was slightly thickened and more than normally adherent to the thoracic wall and lungs.

On pressing the lung between the fingers a number of very small hard nodules were felt scattered about and an inch away from the margin. No such nodules were felt at the base. The external appearance of the lungs was pale. On cutting the lungs into pieces many fine tubercular nodules were seen. In some places they were scattered and in other places they were matted (some pieces have been sent).

Heart.—The pericardium was lined with a thick coating of fat at the auricles. The size and appearance of the heart was normal. On cutting open, the nuricles and ventricles were normal.

The carcass was burnt at once.

A. B. BOPAYYA, G.M.V.C.,
Veterinary Assistant Surgeon,
Coorg Forest Department.

EXTRACTS.

USE OF EMPIRE TIMBER.

PLEA TO ARCHITECTS.

With the object of directing attention to the possible uses of timber from Empire sources the governors of the Imperial Institute yesterday entertained at luncheon members of the Royal Institute of British Architects.

Mr. Douglas Hacking, Parliamentary Secretary to the Department of Overseas Trade and president of the governors, who presided, said that there was a growing movement throughout the whole of Great Britain to use more and more the products of the Empire. The industries of the country utilized annually enormous quantities of structural and ornamental woods, and practically the whole of the supplies were imported. To a great extent, import of the required material was unavoidable, but a less satisfactory feature was the relatively low proportion of the import derived from Empire sources. The average value of the total imports of timber of all kinds into the United Kingdom during the past few years had amounted to about £46,000,000 per annum, only 10 per cent. of which represented timber of British origin. There might be some limit to the extent to which our needs in timber could be supplied from Empire sources, but it was a great deal higher than 10 per cent. The oversea countries had most important resources of both soft woods and hard woods.

The ultimate—perhaps the penultimate—reason why the Empire timber import was so small was that architects did not specify Empire woods in their professional practice. They were the final arbiters nearly always; they could recommend the woods to their clients and demand them from their timber merchants,

In most cases they did not do so because the woods in questions had not been brought objectively to their notice. It was for that reason that they had been invited to inspect the Exhibition of Empire Timbers before it closed on 30th May. There was good evidence of the practical value of this exhibition. Numerous inquiries had been received from many classes of timber users, and one of the best known firms of furniture manufacturers had decided to embark definitely on the manufacture of furniture from Empire woods and to hold an exhibition of their products before long. A letter from the Conservator of Forests in British Guiana stated that as the direct outcome of inspection of a special sample of greenheart wood in the exhibition, the Colony received an order for 10,000 cubic feet of greenheart which was immediately followed by a second large order, and further business was expected.

The guests afterwards inspected the exhibition under the guidance of Lieutenant-General Sir William Furse, the director of the institute.—(*The Times.*)

DUTCH ELM DISEASE.

Action by Forestry Commission.

Much interest has been caused by the articles and correspondence which have appeared in *The Times* during the past few days calling attention to the damage inflicted on elms on the Continent by the Dutch elm disease and urging that effective steps should be taken to prevent the spread of the disease to this country. Nature lovers in general, and private owners of elms in particular, will therefore, be relieved to learn that the Forestry Commission will next week begin a survey in Hertfordshire of elms likely to be affected, in order that, if possible, further data may be obtained of a disease which an official of the Commission confessed yesterday was still somewhat of a mystery to mycologists.

The disease obtained a footing in this country last summer, when an elm at Totteridge, Hertfordshire, was found to be infected and was destroyed. The Forestry Commission have now appointed a mycologist to go down to Totteridge to carry out a thorough

examination of all suspicious-looking trees in the neighbourhood The material thus obtained will be sent to Edinburgh, where it will be examined by Miss Mary Wilson, acting under the guidance of Dr. Malcolm Wilson, who is consulting mycologist to the Commission. At the request of the Commission, Miss Wilson visited the Continent last year and carried out a complete investigation into the disease at various centres. Until the results of the preliminary inquiry at Totteridge are known, it is not possible to state in what directions the survey may be extended, but the Forestry Commission are hopeful that the elms of this country may be spared the fate of some of the beautiful trees in Holland and Germany. They state that, while the fact that even one case of the disease has been discovered in this country is disquieting, there is no cause for alarm, but there is urgent need for extensive research into the origin of the disease and possible methods of prevention.

An official of the Commission stated yesterday that it was now generally agreed, as was pointed out in the article which appeared in *The Times* last Saturday, that the fungus *Graphium ulmi* was the real cause of the disease. The difficulty with which research workers were faced, however, was that the life history of this fungus had yet to be worked out properly. The fungi were spread by means of fructification, and Dr. Wilson recently found some fructification in old dead wood. This was believed to be only the second recorded case of fructification being found in nature. Fructification was obtained more easily from the culture media, but no one had ever found fructification on a standing or recently felled tree. The tree at Totteridge was probably attacked by *Graphium ulmi*. The material found in the tree had been sent to Holland and Germany, and the reports received had confirmed Dr. Wilson's diagnosis.

One of the most difficult parts of the problem was that the first signs of the disease were not very easy to recognize. The initial form of the disease was a yellow discolouration of the green leaves at the head of the tree, or at the tips of the side branches. The symptoms spread until each leaf and branch was affected. A tree might die in one growing season, or the process of destruction might

be much more gradual. There was nothing about the appearance of this particular disease to distinguish it from any other disease produced by an attack of fungi on an elm.

The disease was evidently extremely contagious, as was shown by its rapid spread on the Continent during the nine years in which it had been known, and, in the case of the Hertfordshire elm, it was possible that somebody might have imported an elm from Holland and planted it at Totteridge. It was also possible that infection might be carried by birds. One of the reasons why it was necessary to take special care in this country was the existence of such a large number of old elms, old trees being much more vulnerable to the disease than younger ones. The order of the Ministry of Agriculture issued in December, 1926, prohibiting the importation of any living elm tree into this country had done much to keep out the disease. Climatic conditions were undoubtedly responsible for the rapid spread of the disease on the Continent, and it was possible that the conditions here were not so favourable. The greater warmth experienced in Holland migh be a factor in causing an epidemic of the disease.—(*The Times.*)

DIOSCOREA ALATA.

Mr. I. H. Burkill exhibited a tuber of *Dioscorea alata* L., with the shape of a horse-collar, newly received at the Royal Botanic Garden, Kew, from Mrs. D. J. Collins, of Sriracha, Siam. This is not abnormal, but one of the numerous cultivated races of this yam, a race found from the Philippine Island westward to Siam and the Malay Peninsula.

He remarked that primitive man, painfully aware of the labour of digging for his food the tubers of the ancestral *D. alata,* from three feet down, when he started to cultivate or to care for them selected for shortness, and so in time provided himself with rounded and variously-branched tubers of new races. But the elongated deep-burying yams remained the more tender and desirable. Rumpf tells how, in the island of Buton, a device had been arrived at for growing these deep-burying yams through horizontal bamboos placed close to the surface of the soil, that when wanted they might

be got easily. In recurving yams, such as the one exhibited, nature has given man another means of saving his labour. When a set of one of them is planted, the new tuber starts its growth downwards, recurves in the soil, and, unless earthed-up, extrudes. When it extrudes, its growth is liable to be stopped; but if earthed repeatedly it may be got to grow the season out, the positive geotropism with which it started having turned into a negative geotropism. Secondary tubers arising by the side of the first, and of course later, possess negative geotropism from the beginning, and grow upwards. This geotropic change seems worthy of investigation, and, as the race is to be cultivated at Kew, there will be an opportunity for anyone interested to investigate it.

Such recurving yams cannot survive as wild plants; wild pigs would not allow them to do so. They certainly took their origin under cultivation.—(*Linnean Society of London, General Meeting, 15th March 1928*).

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FORESTS AND CLIMATE.

We have lately had under consideration the climatic factors, more especially rainfall, in the natural distribution of deodar, and through the courtesy of several forest officers and the publication entitled "Monthly Rainfall of India" for 1925 we have been able to collect figures of the monthly rainfall both of places typically within the limit of the natural distribution of the species and of those where the tree is not found naturally, although it has been more or less extensively planted. A study of these figures will do much to explain why the deodar is not found on the outer ranges of the Himalayas in Kangra, Chakrata and Mussoorie, and why it is absent in a wild state from the whole of Kumaon.

The D. F. O. Chakrata (Mr. Hopkins) has also brought to notice the unthrifty condition of the plantations at Bodyar on the plains side of the outer range where the trees have developed short conical boles with little promise of satisfactory financial results at maturity. We have seen the same phenomenon in the deodar plantations on Cheena at Naini Tal.

The distribution of deodar is given in detail on page 1097 of Vol. III of Troup's "Silviculture of Indian Trees"; roughly it is found throughout the western Himalayas from Afghanistan to Garhwal at elevations of 4,000 to 10,000 ft. Troup gives its

eastern natural limit as the Dhauli river, a branch of the Alaknanda, one of the main streams of the Ganges, but Collier reports deodar as occurring in Nepal. It is entirely absent from the eastern Himalayas in Sikkim and Bhutan. As regards rainfall Troup states "the great majority of the best deodar forests are found where the rain fall varies from 40" to 70" ; in these regions most of the rain falls during the south-west monsoon from June to September, while there are often considerable falls of snow during the winter from December to March." This statement is qualified by a reference to the existence of deodar in the inner dry valleys of the Sutlej, the Kunhar, the Swat rivers and elsewhere. Deodar is probably at its optimum in Kashmir and the first seven places on the list (kindly supplied by Mr. Lambert) show an average of 17·81 inches of rainfall for the months January, February and March as compared with an average of 10·19 inches for July, August and September, the three monsoon months. The places have all more winter rain than monsoon rain.

The next place on the list is Naggar (Kulu) with 15·71" winter rainfall compared with 21·77" monsoon ; Kotgarh (Simla *Hills) with 8·41" winter and 23·70" monsoon—shows a drier* winter climate and a heavier monsoon rainfall. Simla with 7·90" winter and 40·34" monsoon grows deodar of inferior quality. Kilba (Upper Sutlej) is in the dry zone and has 12·53" winter and 9·16" monsoon. Progressing further eastward, Chakrata situated on the outer range has 11·72" winter and 44·79" monsoon. Chakrata is not typically within the deodar zone according to Mr. Hopkins who maintains that this species is only found *naturally on the other side of the range, where the rainfall is* much less. Next we have entered a few places definitely out of the natural zone but of suitable elevation and where artificially planted deodar will grow. It will be observed that Mussoorie and Naini Tal both on the outer range have an excessive monsoon rainfall while Ranikhet and Almora behind the outer range seem to have a winter too dry for deodar to thrive. It has been obvious to us for some years that where it is sought to cultivate deodar artificially out of its natural habitat in such places as

Chakrata and Ranikhet only the coolest and most favourable sites should be attempted. A difference of a few yards may mean the difference between a healthy tree and a yellow sickly thing. On anything but the most favourable sites the cypress (*Cupressus torulosa*) is likely to give better results. We were unable to obtain monthly rainfall statistics for places typically in the deodar zone in Chamba and Hazara. We have no doubt that it is rainfall which makes the difference between the deodar of the Chamba range and that of Tisa and Bandal. In the former range the firs are dominant, ousting the deodar, while in the dry climate of Pangi deodar is entirely dominant and the firs of no account. A study of the monthly incidence of rainfall is likely to be of considerable use to the forester as there is no doubt that much money has been spent in planting deodar in what after all may be an unsuitable climate. What deodar really wants is a climate with a rainfall from 35″ to 50″ of which a considerable amount falls in the winter, preferably in the form of snow.

Statement of

Name of place.	January.	February.	March.	April.
Handwara (Kashmir)	6·52″	6·23″	8·36″	6·89″
Baramulla (Kashmir)	4·78″	4·47″	6·59″	6·37″
Uri (Kashmir)	5·78″	6·31″	9·01″	7·81″
Tithwal (Kashmir)	5·04″	5·16″	6·32″	6·08″
Ramban (Kashmir)	6·54″	5·61″	6·00″	3·87″
Bhaderwah (Kashmir)...	3·79″	6·97″	7·32″	5·70″
Kishtwar (Kashmir)	3·75″	4·21″	5·92″	4·70″
Naggar (Kulu)	5·83″	5·16″	4·72″	3·50″
Kotgarh (Simla Hill)	2·19″	2·67″	3·55″	2·77″
Kilba (Upper Sutlej)	3·65″	3·64″	5·24″	3·48″
Chakrata	4·35″	4·31″	3·06″	1·79″
*Mussoorie...	2·76″	3·18″	2·32″	1·27″
*Naini Tal	3·05″	3·11″	2·48″	1·24″
*Ranikhet	2·40″	2·18″	2·13″	1·37″
*Almora	2·01″	1·79″	1·97″	1·14″
*Simla	2·47″	2·69″	2·74″	2·28″

* FOOTNOTE.—Normal figures taken from the "Monthly

monthly rainfall.

May.	June.	July.	August.	September.	October.	November.	December.
2·86″	2·27″	2·32″	2·88″	2·09″	2·09″	1·13″	2·87″
2·72″	2·49″	1·66″	2·18″	1·69″	1·58″	0·82″	2·98″
3·49″	3·75″	3·63″	4·08″	3·12″	1·89″	1·02″	3·96″
2·29″	3·45″	4·48″	4·36″	2·20″	1·94″	0·97″	3·50″
2·07″	2·43″	6·18″	5·36″	3·12″	1·07″	0·70″	3·05″
2·56″	2·75″	5·77″	5·09″	2·19″	2·57″	1·11″	3·44″
2·40″	1·97″	3·48″	3·02″	2·48″	1·26″	0·80″	2·19″
1·57″	2·61″	8·34″	9·27″	4·16″	1·18″	0·82″	2·96″
3·06″	4·34″	9·80″	9·57″	4·33″	0·86″	0·48″	0·94″
2·46″	1·52″	3·55″	2·92″	2·69″	0·84″	1·08″	1·34″
2·44″	8·12″	19·20″	18·69″	6·90″	0·96″	0·58″	1·28″
2·44″	9·66″	29·75″	30·89″	10·75″	1·10″	0·49″	0·98″
3·21″	14·60″	27·72″	26·19″	12·65″	2·34″	0·42″	0·93″
2·33″	5·90″	12·95″	13·47″	6·67″	1·54″	0·36″	0·83″
2·28″	5·93″	10·40″	9·74″	5·20″	1·27″	0·22″	0·60″
2·80″	7·25″	16·97″	17·43″	5·94″	1·00″	0·50″	1·00″

Rainfall of India" for 1925.

PASTURE AND TIMBER PRODUCTION.

In order to grow clean timber the desirable density of a crop between the sapling stage and maturity allows only of a comparatively small production of grass, the exact amount depending on the types of grasses, types of overwood and the locality; it tends to increase with the age of the crop, because speaking generally the older the crop the more open the canopy. The thick humus layer under a dense coniferous pole crop, coupled with the density of the canopy may preclude grass altogether for several decades, although after a thinning patches of grass will probably appear following heavy rain; this is particularly noticeable in kail, spruce and fir forests.

In many of the Reserved and Protected forests grazing is a right and in many parts of the Punjab there is a good market for cut grass, therefore it is only natural that the local population regards the forest from the point of view of its grass bearing capacity.

In order to increase the capacity they frequently resort to incendiarism thereby gaining a temporary increase of grass through the destruction of the humus and frequently of standing trees. So great has been the damage that of recent years departmental burning (in winter) was introduced in certain divisions so as to prevent or at any rate minimize the effect of fires during the hot season. [*vide* Fires and fire protection in chir (*Pinus longifolia*) forests by H. M. Glover, I.F.S. (with a note by N. G. Pring, I.F.S.): *Indian Forester*, June 1927].

In many parts the wholesale lopping of oak and deciduous species is converting areas of broadleaved or mixed coniferous and broadleaved forests into pure coniferous crops thus increasing the danger of fire.

On a still day a fire which starts on a hillside will burn uphill covering an ever widening fanshaped tract and getting more intense the higher it spreads.

On steep ground loose burning matter, such as cones, starts a succession of conflagrations farther and farther down the slope; however, the resulting damage to the crops is generally small.

I have never seen fire burning downhill of its own accord except on very gentle slopes when fanned by a wind, and departmental burning downhill entails starting just below the top and continually igniting the humus layer or undergrowth along lower contours.

From studying the ground burnt over either departmentally or through incendiarism I have reluctantly come to the conclusion that any form of burning is injurious as it causes erosion, except where a heavy bush undergrowth of species such as *Myrsine africana* and *Berberis Lycium* previously covered the ground, the roots of these species are not destroyed and they are sufficient to hold the soil; although they generally shoot again, grass is enabled to establish itself and often succeeds in replacing bush growth.

Where there is a dense and seemingly impenetrable humus layer of pine needles (*Pinus excelsa* and *Pinus longifolia*), grasses nearly always come through during and after the wet monsoon and following the winter rains, except under dense pole crops.

As a silvicultural aid, this humus layer is an invaluable and perfectly natural feature. Not only does it protect the soil from erosion but while allowing it to reach the ground it holds the rainfall and prevents evaporation. However dense, it is very doubtful whether chir humus ever sours the soil in the manner that beech or hornbeam do. On the other hand kail humus probably does do so, hence the difficulty of obtaining kail regeneration over pure kail (*Pinus excelsa*) areas.

It is true that repeated fires have extended the chir zone upwards beyond its natural limit in many parts of the Himalayas and this seems to have given rise to the theory that chir is associated only with fire.

It is also true, that given fire protection, chir will disappear above its normal limit, and this is already shown in some of the Patriata and Charihan forests of the Rawalpindi West Division where older poor quality crops of chir are being replaced by healthy kail. On the other hand at the lower limit of the chir zone there is not the slightest doubt but that incendiarism is causing the more xerophytic species such as *Zizyphus* spp.,

Dodonaea viscosa and *Carissa spinarum* to succeed chir. Here again it can be seen how with fire protection chir re-establishes itself in scrub forest; instance an area below Sambli and forest around Keral in the Rawalpindi District.

In the Rawalpindi Divisions this is the burning question :—

Are we to burn departmentally in order to obtain grass for the villagers who have the right to graze three-fourths of our Reserved and the whole of our Protected forests, in addition to special rights in some of our Reserved forests?

There are several reasons for not doing so—firing in a sub-tropical dry zone results in the extermination of all except the coarsest and least nutritious grasses, on steep hillsides it results in erosion and undoubtedly it damages the trees.

Burning under control only where a dense brush-growth has established itself is permissible because such an undergrowth not only prevents grass but also competes seriously for sub-soil moisture with tree growth and prevents regeneration.

The fact is that it is impossible to exploit a forest economically for timber and pasturage where the maximum production of clean timber is the aim.

It is undeniable that for the community as a whole the necessity for pasturage for dairy produce may be greater in some of the sub-tropical districts than that of timber.

In the alpine and sub-alpine zones of the high hills it is certain that it would be more beneficial to the public were we to run some of the unexploitable mixed forests of spruce, fir and oak as *Prés boisés* under controlled pasturage management, which would necessitate rotational grazing, a certain amount of grass cutting and stall feeding in winter, control of animal migrations and fixing the head of cattle allowed on any given area.

The writer spent two months in the *Prés boisés* of the French and Swiss Jura and the lower Alps at various seasons and two points are pre-eminent :—

1. That the scattered forest is retained to prevent erosion and retain the water supply, to give shelter to the cattle and to supply the purely local demand for firewood and timber, but that there

is no exploitation of timber for export to the densely populated zones below.

2. That firing the grass for a greater immediate supply was forbidden because the ultimate deterioration of ground thus treated was realized.

In many parts of the Punjab the zamindars burn the hill forests in order to convert them to open pasture land by destroying the trees.

One of the reasons being that they can make large profits by selling grass to the migratory herds of cattle coming from the higher hills, so that pasture management in the alpine and sub-alpine zone would greatly improve the situation lower down.

In these low hills the Forest Department is struggling to save the chir forests by departmental firing, thus causing a gradual deterioration over certain areas and at the same time failing to prevent the more rapid deterioration through incendiarism over other areas.

Here again it might be better to run certain of the chir forests entirely for pasturage and resin.

Artificial aid in order to establish the most nutritive grasses suitable to the zone would be necessary, and, until they had been established, a certain amount of very carefully controlled firing to combat bush growth would be necessary.

To begin with only grass cutting after seeding should be allowed, this could be followed by rotational grazing over a proportion of the area when the ground become fully stocked with grasses.

Before initiating any pasturage scheme it would be essential first to experiment over certain selected areas with the closest co-operation of the Agricultural Department in various types of forests. Whereas the study of the *Prés boisés* of the Alps would be of great value when dealing with our high level forests; a study of the conditions in the pasture forests of the South Western States of the U.S.A. where the climate is very similar to that of the low hills and sub-montane tracts of the Punjab would also be of great guidance.

During the next ten or twenty years we shall see whether or not it is possible to regenerate and maintain our Reserved and

Protected forests in the low hills in the face of a certain amount of hostility culminating in incendiarism; facing past and present facts squarely the issue appears to be very doubtful, so that there is a risk that fires, whether started with intent to destroy the forests or departmentally in order to save the crop, will result in devastating erosion and desiccation.

Grass land appears equally well able to hold the soil and to preserve the water supply provided that it is not overgrazed, overcut or burnt, therefore, the idea of converting a fraction of our timber forests to pasture woods is worthy of careful consideration.

N. G. PRING, I.F.S.,
Working Plans Officer,
Rawalpindi West Division.

[The grazing problem in India is the same old story of "something for nothing." The Forest Department gets little or nothing out of grazing in tree forest. The grazing in such areas is mostly worthless and if it were possible to improve it nobody would pay for the better pasture. It must be realised that the alpine grazing in the higher hills is entirely seasonal and between June and September abundant. It is not this but the winter grazing and the grazing round villages that does the damage. So long as cattle are worthless nobody will spend money to feed them. The moment valuable cattle are kept nobody will graze them in tree forest.—ED.]

THE GODS OF COMPOUND INTEREST AND THE FETISH OF SUSTAINED YIELD.

Mr. Smythies in his article on plantations and compound interest in the June number of the *Indian Forester* seems to me to spoil his argument by going to extremes, although he does not really go to the root of the matter, nor does he give any reason for including the teak *taungyas* of Burma under his category II B (plantations that are intended to replace the capital being felled elsewhere, and to keep the revenue producing capacity

of the estate at a constant level). The first point I want to criticise is his suggestion that Government might put money out at compound interest, as if this was the only alternative, and as if Government were an individual working for its own ends entirely, while in fact it is supposed to work for the good of the country as a whole. Looking at it from this point of view and, for the present, from a financial point of view only, Government would be benefiting the country as a whole in remitting taxes rather than making unprofitable plantations, as, by the remission of taxes, money would be made available for private investment, thus developing the resources of the country and adding to its wealth, or the money could be spent by Government by developing the country in other ways than plantations, such as by making roads and bridges. Mr. Smythies seems to think that money accumulates interest merely by allowing it to lie in a bank.

The question will be dealt with first of all from a financial point of view only. When there is a forest crop on the soil this crop must be managed with two objects, firstly, to get the best revenue possible from the increment, and, secondly, to increase the capital value of the forest as much as possible. I will deal with the question of revenue and increment first. Mr. Smythies states that Government "want a sustained yield of deodar timber for the well-being of industry and the community generally." I will discuss these objects later, but one object of a sustained yield, which Mr. Smythies has overlooked, is a financial one, namely in order to stabilise the market for timber and provide a supply which will approximately equal the demand; unequal supplies from year to year would be financially unsound and unbusiness-like. In dealing with a forest which has not been worked in the past, or has only been skimmed for the best timber, the question of over-mature stock has to be taken into consideration. As it is not putting on any increment it would be best, from one point of view, to dispose of it as quickly as possible; but this would produce a glut on the market, and it is therefore necessary to dispose of it slowly in order to maintain the market ? The method of control for regulating the disposal of over-mature timber depends on silvicultural and extraction questions, but it must rest

finally on a financial basis. The yield from the over-mature stocks should be treated as a gift from previous generations which this generation is very lucky to have; and the falling off in the supply as a result of their exhaustion should not be looked at with alarm but treated as unavoidable; moreover it is likely to be at least partially compensated for by a higher price being obtained when the supply falls off. The yield will also fall, owing to the decrease in the area under forest, resulting from the extension of cultivation and the increase in the population; but Government will benefit from this in other ways, by the increase in land revenue, capitation tax and general wealth of the country so that this decrease need cause no anxiety. The yield must be fixed according to the value and increment of the existing crop and has no connection with any future crop except as far as silvicultural methods of regeneration are concerned; but no method should be adopted before its financial effect on the yield of the existing crop has been taken into consideration, as well as the welfare of the future crop.

Now we come to the second object, increasing the capital value of the forest growth. From a financial point of view, every anna spent must be justified; but, because we have not sufficient data to justify the present forest policy from this point of view, Mr. Smythies wants to try and prove that it is not necessary to justify it financially and states that his "main hypothesis" is "that Government have a *Forest* Policy" and he describes this "*Forest* Policy" as wanting "a sustained yield of timber for the well-being of industry and the community generally." As already stated, this definition disregards financial considerations altogether, and, as forestry is supposed to be run on business-like methods, is obviously wrong. It is the duty of Government to lay down the forest policy of the country, but it is the duty of the forest officer to go into the question from a financial point of view and to point out to Government what the cost is of deviating from a purely financial policy. It is the duty of the forest officer to fix the rate of compound interest for financial calculations, after consulting with financial experts; and it is no use trying to hedge the question

by altering the rate of interest when the rate originally fixed fails to show that expenditure being incurred is profitable. The idea that Government might accumulate the money at compound interest must be got rid of entirely; but it must be remembered that the finances of the country are in trust with Government for the benefit of the country as a whole. If Government decides on managing forests with other objects than purely financial, such as prevention of erosion, local supply of forest produce, maintenance of employment in the timber trade, the cost must be worked out and pointed out to Government and it is for them to decide whether the policy justifies it or not.

Mr. Smythies does not give much information about his deodar forest; but it is obviously an extreme case, as he says that, if the forest was felled and no plantations at Rs. 40 per acre were made, the result would be a waste of weeds. Most forests will regenerate themselves to a certain extent if fellings are made, and in the case of the teak selection forests of Burma this occurs where there is not an excess of the middle age classes; but even in the case of the deodar forest there is no financial justification for saying as Mr. Smythies does that "the creation of the plantation has produced income that could not otherwise justifiably be realised." On the other hand, if no profitable method of regeneration is to be found, it is better to leave the land to become a waste of weeds than to spend money on unprofitable regeneration, unless Government considers it is for the good of the country that these plantations should be grown at a loss of say 2 per cent. per annum on the money invested in them. No business-like farmer would say :—"It does not pay me to grow another crop on this land, owing to the large amount of money that has to be spent to make it a success; but I have made money on selling the last crop, so I will spend some of it on planting a new crop, and thus keep my men employed although I would get more money by depositing the money in a bank." By depositing his money in the bank it will become available for other profitable concerns and will increase employment economically. Some limit must be fixed beyond which expenditure is not justified and if we cannot fix that limit, owing to lack of data, let us

admit that we are working in the dark and try our best to get out of it by collecting data.

To show how much we are working in the dark Mr. Smythies according to the usual custom, proposes "putting intermediate yields against cost of tending and upkeep." I don't know anything about the deodar forests, but from what I know of teak plantations I think this puts the value of the intermediate yield much too low.

In the well-known teak regeneration area of 106 acres formed in the year 1911 by Mr. Blanford, I.F.S., in Bilumyo Reserve, Katha Division, now in Myitkyina Division, the thinning and cleaning in the year 1927-28 cost Re. 1 per acre and the revenue from the sale of thinnings was Rs. 2·3 per acre. This area was regenerated naturally at a cost of Rs. 38·1 for the first five years and subsequent expenditure upto and including a thinning in 1923 was Rs. 1·5 per acre. There is no record of revenue from previous thinnings but this would be a very small item. Discounting these figures to the present time at 4 per cent. compound interest gives a present net cost of Rs. 66·4 per acre excluding overhead charges.* I leave it to the reader to work out the profit but I think there is no doubt that it will yield more than 4 per cent. interest.

In regard to weeding plantations in Burma, it would almost certainly not be justifiable from a financial point of view to save Rs. 10 per acre when Rs. 30 per acre has already been spent on the plantation, if the spending of Rs. 10 extra will mean the difference between a good and a bad plantation ; but before further plantations are made, it should be considered whether a cost of Rs. 40 per acre is financially justifiable, taking into consideration the objects of management laid down by Government. It is no use saving money and producing bad plantations ; but on the other hand the tendency to make the plantation too perfect regardless of cost must be avoided, as small defects tend to disappear when thinnings are made. This is a question which requires research by means of sample plots. As long as data are not available for working out the cost value of regeneration

* The average period since establishment is taken as 14 years.

work, the best policy is to limit the plantations to areas which are obvious profitable owing to the easy sale of thinnings.

Mr. Smythies suggests that losses should be written off annually. I agree that this should be done when the planting is done to benefit the present generation ; but, when plantations are made which will not yield their final crop for 100 years or more, it is only fair to debit the costs to future generations.

Forest policy requires to be discussed in conjunction with financial policy and the two should not be treated as being in opposition to each other. In general it will be to the advantage of the country to grow forests to maintain the supply of forest produce for consumption in the country, even if the interest on the money invested is less than what could be obtained by investing it in other equally secure projects; but the country, as a whole, would lose if forests are grown at a cost, which will yield a rate of interest lower than the normal, in order to produce timber for export; although certain interests, such as the timber trade, benefit from such a policy.

The leader in the March number of the "Indian Forester," as Mr. Smythies quotes, concludes by saying that "we need not be too particular to propitiate the gods who preside over tables of compound interest;" but Mr. Smythies appears to me to wish to set up another fetish called alternatively "sustained yield" and "*Forest* Policy" and to grow trees just for the sake of growing them or at least regardless of the financial loss to the community.

Finally there are two points I wish to emphasize. Firstly, expenditure on a new forest crop has no connection with the reaping of the existing crop, and I entirely disagree with the point of view of the March leader "that in the case of existing forests the cost of replacing a felled crop—whether naturally or artificially—should be charged against the gross sale value and should not be compounded for the length of the rotation." And secondly, the finance of the Government must not be separated from the finance of the country as whole. This last point of view makes compound interest a reality and not a god to propitiate.

G. H. OGILVIE, I.F.S.

WOULD YOU LIVE IN NEW ZEALAND ?

(TO A FOREST OFFICER.)

Has New Zealand any attractions to offer the retiring Forest Officer and his family? As in most situations, money is the key note to the answer. Certainly it is possible to live a comfortable, cheery, middle-class life in New Zealand on an income that would yield a mere existence in England. Although the standard of living is high, and the cost of living is high, yet the essentials are within the reach of all. Foodstuffs—nearly all produced in the country—are excellent in quality, and reasonable but not cheap.

The climate is undoubtedly one of the healthiest in the world, much colder and rougher in the winter than is generally supposed. If you glance at a map and notice that unbroken expanse of water between New Zealand and the South Pole, you can readily visualise what the southerly gales bring in their train. The northern portion of the North Island escapes these gales, and consequently the winters are very mild. Auckland, with a population of over 100,000, is known as the Queen City, and is a veritable paradise. Its beautiful landlocked harbour encourages all the water sports, motor boating and yachting being particularly popular. To the north of Auckland lie the big game fishing waters so well advertised by Zane Grey, the American novelist, who is returning now on his third expedition, lavishly equipped with five fast motor launches and three ready-to-erect houses. Big game fishing is at all times an expensive sport; but brown and rainbow trout are very plentiful and are found in most of the streams and rivers and in some of the lakes.

Golf and tennis are comparatively cheap and easily accessible to all.

Education is sound, and there is no need for either boys or girls to leave the country to finish.

It is an exploded idea that anyone can make small farms yield a dividend in New Zealand. Farming to-day is a scientific business and requires the study of a lifetime, plus a reasonable amount of capital invested in the land, to make success even possible. Indeed, a farmer in the North Island will be very chary about buying land in the South Island until he has studied the

changed conditions—climate, quality of the land, etc., necessitating an entirely different method of farming. The same applies to fruit and dairy farming. Expert knowledge is absolutely necessary.

Labour in all its forms is a vexed question. That "Jack is as good as his master" is not a literal but an actual fact in New Zealand. Most middle-class households are run with a cook and a housemaid, or, if there are young children, a general and a housemaid, or more economically with one general; and a wonderful servant she can be. She expects to do the cooking and the housework. She does not clean the boots, which, unless you keep a boy about the back door—an extravagance not usually indulged in—you are expected to do for yourselves. According to her capabilities a general is paid from 25 to 35 shillings per week and found. Usually a char at 5 shillings the half day does the laundry at home. A gardener, by the day (not found), is paid from 12 shillings to 15 shillings.

Most New Zealand women are capable of filling any position in the house, and of training good raw material into useful servants.

Motor cars are the order of the day. Recent statistics showed one to every eleven of the population, ranking second in the world to the United States of America.

There is much to be said *for* the free life this little country offers, and much to be said *against* its isolated position. The fastest mail service to England takes twenty-eight days (*vid* Vancouver or 'Frisco) and generally speaking the journey to England takes five weeks by passenger service.

[The above is a reprint of an article by Mr. D. Lord of 46 Essex Street, Masterton, New Zealand.—ED.]

A VISIT TO A RAFFLESIA RESERVE.

While stopping at Fort de Kock in Sumatra I happened to see in a photographer's shop a print of *Rafflesia Arnoldi* fully opened. On making enquiries at the hotel it transpired that a former official of the district who was greatly interested in botany

had found a spot where these plants were unusually numerous and had made a reserve for it.

There was no news of whether there were any flowers open at the moment, so we took our chance of finding some and went off to the reserve, which is situated near a village called Batang Paloepoeh about 12 km. north of the town on the main road to the port of Sibolga. A path had been made from the village to the reserve but it was in some disrepair as now no one takes much interest in the reserve.

The reserve is an area of a few acres fenced in on the steep sides of a very damp depression on the hill side. The forest consists of small trees with a dense undergrowth of ferns, balsams, *Acanthaceae* of sorts and such like squishy plants while the number of *Cissus* sp. on which the *Rafflesia* grows is very large.

We were out of luck for there were no flowers open. There were the remains of one, of which only the fleshy disk was recognisable and we found four buds of different sizes of which the accompanying photograph (plate 39) shows the largest, looking for all the world like a fine drum head cabbage that has been touched by frost. This one, as I gathered from the guide, though my knowledge of Malay is a negligeable quantity, would be open in about a month. Behind the bud can be seen one of the slender stems of the host plant. The watch chain hung on the right of the bud gives the scale.

To console us for our bad luck in missing the flower the day was most gloriously clear and gave us splendid views of the neighbouring volcanoes. If anyone had told me before we started this trip to Sumatra that we should find ourselves at the equator literally basking in the sun and enjoying a fresh keen breeze I should have called him a liar and yet so it was. The most perfect summer day in England could not have beaten it and yet we were at barely 3,000 ft. elevation.

It is a pity that the guide books do not mention the fact that this extraordinary plant can so easily be seen, for most tourists would walk three quarters of a mile to see the biggest flower in the world.

W. A. ROBERTSON, I.F.S.

BUD OF RAFFLESIA ARNOLDI.

VIABILITY OF WEATHERED TEAK SEED.*

One lb. of teak seed weathered in 1926 which was due to be sown in May or June of 1927 was kept dry, well-packed in paddy hay. This was sown in June 1928. The total number of seed sown was 1,600 out of which only 36 seed germinated. The germination took place within a week. The object of this experiment was to test the vitality of weathered seed. This experiment gave only 2¼ per cent. success. This shows that bulk of weathered seed does not retain its vitality for more than one year.

HONAVAR, KANARA,
31st July 1928.

M. S. TUGGERSE, P.F.S.,
Divisional Forest Officer,
Kanara Coast Division.

FOREST DEPARTMENTAL DITTY.

We burn the ground and dibble
    The Teak seed in the soil;
The rats and mice which nibble,
    We take some means to foil.

We close the coupe to grazing,
    For that is half the battle;
It really is amazing—
    The harm that comes by cattle

All good things around us,
    Are sent by heaven above;
But cows in coupes we chase with whoops,
    For *them* we do not love!

With very close attention
    We watch and pray and weed

And I would like to mention
    That *other* species' seed

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* (Continuation to the article on Teak Seed which appeared on pages 163—170 of the "Indian Forester" for April 1925.)

Is introduced and tended,
    Nor ever is forsaken—
So carefully is blended
    The Mixture—To be Taken !

Junglewoods around us,
    Are sent from heaven above;
You have to seek infrequent Teak,
    The truth of this to prove !

With *planting* and *protecting*,
    We have enough to do ;
But *felling* and *detecting*,
    Must be attended to.

Recalcitrant contractors,
    And *acting auctioneer*,
Are sundry little factors
    Which do not tend to cheer!

Questions that astound us,
    Arrive from heaven above;
Direct they go to R. F. O.—
    On whom such things we shove.

None other make the money
    WE give the State each year !
From Teak to jungle honey—
    (And if the Customs jeer,
We say that Import Duty
    From cartridges to cheese,
Is unromantic booty
    Compared to things like these).

All official heroes
    Are sent by heaven above;
By Him who makes the birds and snakes
    The cobra, and the dove.

H.J.C.M.

EXTRACTS.

JUTE STALK.

A circular issued by the Department of Industries, Bengal, says :—

It was suggested in the "Amrita Bazar Patrika" dated the 25th November 1926, that the jute stalk—a large quantity of which is wasted in Bengal—may be used as a new raw material

for the manufacture of card-board or paper. According to the writer the stalk contains about 60 per cent. of cellulose.

The subject was taken up for investigation by this Department. Samples of jute stalk from different parts of Bengal were obtained. These have been reported on by the Officer-in-charge Paper Pulp Section of the Forest Research Institute, Dehra Dun, as follows :—

The fibre contents are of poor quality, short and weak and with little felting power. Preparation by soda digestion and bleaching proved to be much too costly for the quality produced. Digestion with lime and no bleaching has given a coarse board which cracks very easily when bent. It would not make a good board without a large admixture of straw. The digestion for this involved the consumption of 25 per cent. of lime on raw material and 5 hours' steaming at 80 lbs. pressure, which for both items is more than straw requires.

It will thus be seen that the paper-making value of jute stalk is very low, and it can only be used as a material for card or straw board in admixture with other paper or board-making materials.—(*"Capital", 2nd August* 1928).

WORK OF THE FORESTRY COMMISSION.

(80,000 ACRES PLANTED SINCE 1920.)

The Forestry Commission for England and Wales, during the planting season which recently ended, planted an additional 16,000 acres, which makes a total of 80,000 acres of new forest areas established since 1920. The work of the Commission is also being augmented by the schemes carried out by private owners. The planting of about 20,000 acres a year is now aimed at, and preparations have been made for the programme during the next three years.

The seedlings lined out in the Commission's nurseries throughout the country number 87,000,000, and the seeds sown this spring were hardwoods, 44,000lb., and conifers, 5,000lb. It is interesting to note in this connexion that for all the native seeds, including Scotch pine, the Commission does its own col-

lection and extraction, and the only seeds imported are those of Douglas fir and Sitka spruce, obtained from Canada and the United States of America, and a few other non-indigenous species.

Thetford Forest, Norfolk, still holds its place as the largest single unit in charge of the Commission. An area of 6,000 acres acquired about four years ago, has grown to 26,500 acres, and about half of this has been planted. It includes the largest nursery in the country, and owing to the favourable conditions for seedling development, more than two thirds of the conifer plants required by the Commission are raised in this forest. Thetford is interesting, not only in consequence of its forest development, but owing to the growth of the scheme of *forest workers' holdings.* The Commission has established there 100 small-holdings, 80 of which are occupied and 19 are in course of completion. The holders are employed in the forest, and a census taken recently showed that, on an average, there was a family of four on each holding. Those who have watched the progress of this scheme express the opinion that the depopulation of the countryside is due more to lack of opportunity than the dislike of rural life.

The work of the Commission at Thetford has had a marked influence on the village of Santon Downham, where a population in 1923 of about 20 people has grown to 250, and the village has become the centre of administration for the forest. The Commission has also placed at the disposal of the Ministry of Labour land at Thetford for two summer camps, capable of accommodating 500 men, to be trained for agricultural work in oversea Dominions. The planting operations and the nursery work provide continuous employment for between 300 and 400 men at Thetford and the number of workers' holdings there will shortly be increased to 130.

SMALL HOLDINGS FOR MINERS.

Other centres of afforestation which are being similarly developed include Allerston, in Yorkshire, Hamsterley (Durham), the Mortimber Forest, on the Shropshire and Radnor borders, and areas in North Wales. The total number of workers' hold-

ings throughout England and Wales at the end of April was 330, and another 103 are expected to be completed this year. There is a possibility of the Commission increasing its activities in this direction in order to meet in some degree the necessity of transferring miners from the distressed mining districts. Already 25 holdings have been allotted for this purpose, and in South Wales ex-miners are being employed in the forests of the Commission. During the past season extensions have been made to forests at Ampleforth and Rosedale, in Yorkshire, the Mortimer Forest, and areas in North Wales, and at Bodmin, in Cornwall. Extensive developments are also anticipated in South Wales, and the Commission hope to double their activities in the Neath Valley when negotiations now in progress are completed. An important area was recently opened near Carmarthen, and the forest there is steadily growing. In the North of England arrangements are being made for the acquisition of a large area in Northumberland, on the Scottish border, and adjoining an area already acquired at New Castleton.

The growth of the young plantations in the different parts of the country is regarded as satisfactory, and the Commission is anxious to secure the co-operation of the public in preventing damage to the new forest.—(" *The Times.*")

SCOTTISH BOTANIC GARDEN.

(MR. H. G. YOUNGER'S FURTHER GIFT TO THE NATION.)

A further gift to the nation has been made by Mr. Harry G. Younger, of Benmore and Kilmun, who in February, 1925, presented to the Forestry Commission, subject to certain reservations, his estate of Benmore, Argyllshire, extending to about 10,000 acres, as a national gift for afforestation purposes and education in silviculture, as well as a national arboretum and botanic garden. The reservations in the main consisted of Benmore House and offices, policies, gardens and shrubberies.

Mr. Younger's new gift is the residue of his estate, as specified, to the same Commission, reserving only for his private use Eckford House, a small villa on the road side, and the river

Echaig which joins Loch Eck to the sea at the head of the Holy Loch. The villages of Kilmun, Strone and Blairmore will also remain under estate management. Benmore is situated about six miles from Dunoon on the Firth of Clyde and the highway used by visitors, who take the Loch Eck tour, runs through the policies.

This supplementary gift is of much value to the Commission, enabling them to pursue their observations and experimental work under the most favourable conditions of soil, climate, shelter, and environment. The area extends to many acres of interesting woodlands, embracing arboretum and gardens where for over 50 years the proprietors have successfully experimented with a diversity of exotic timber-trees and herbaceous plants, which have had a special fascination for Mr. Younger, who is an ardent botanist.

Benmore House, a fine mansion in the Scottish baronial style, added to at different times by respective proprietors, will be used as a college for students in all branches of forestry. It is understood that, owing to the convenience and accessibility of Benmore, the present Forestry School at Beauly will subsequently be transferred there. Mr. Younger vacates the mansion house, etc., in November. The employees on the estate, whose combined service exceeds 300 years, an average of over 25 years respectively, will continue to serve under the new dispensation, with the exception of the estate agent, Mr. Hornby, who proposes going abroad.

The ultimate benefit to the nation of Mr. Younger's gift can best be appreciated by those practically interested in afforestation. The Commission is now possessed of a quite exceptional centre for propagation and experimental work—in fact the largest arboretum in Britain, embracing a wide field of research in science and practice. It is understood that the general public will also benefit. For some considerable time workmen have been preparing Puck's Glen for public use and have erected a rest house there to the memory of Sir Isaac Bayley Balfour, King's Botanist in Scotland, all of which will be formally opened to the public by the British Association when visiting Benmore in September.

In course of time much greater public benefits will materialize, as the intention is to make Benmore the National Botanic Garden

of Scotland. Already some thousands of hybrid rhododendrons have been planted throughout the policies and the shrubbery, containing very many rare plants, has been enlarged.

Mr. Younger is the son of the late Henry Johnston Younger, and is Chairman of Wm. Younger and Co., brewers. He was for many years a director of the North British Railway. For many years he has displayed an active interest in benevolent societies connected with the trade. He is a member of the county council and the hon. president of the Cowal Highland Gathering.—(*The Times.*)

FOREST ADMINISTRATION IN ASSAM.

COMMITTEE OF INQUIRY.

(*Shillong, August 15th.*)

Acting on a resolution moved at the last session of the Legislative Council and accepted by the Assam Government, the Governor-in-Council proposes to appoint a committee, beginning next cold weather to inquire into any alleged defects of the forest system, which tend to produce friction or cause hardship to the people, and advise Government whether and how those defects can be remedied without serious interference with the primary object of the forest system, *viz.*, conservation of the forest resources of the country for future generations. Such defects may include opportunities for oppression and dishonesty on the part of any class of forest officials, but it is not intended that the committee should inquire into individual complaints of malpractices on the part of forest officials, except in so far as it may be necessary for an investigation of the defects of the system.

SILVER FIR FOR MATCH SPLINTS.

In "Indian Engineering" of the 7th July 1928, under the heading "Forest Research in India," at page 6, it is stated that the Punjab tests have shown the wood of silver fir to be unsuitable for match splints. This statement is not strictly correct. The wood of the Indian silver fir when used *green* makes a

very satisfactory "splint": but the difficulty is to obtain *green* wood in match factories located in the plains. The silver fir grows on the higher slopes of the inner Himalaya and has to be brought long distances by water to the plains, so that after six to nine months in the water it is no longer green. If and when railways and good cart roads penetrate to the inner valleys of the Himalaya it should be feasible to use large quantities of silver fir for match splints and match boxes—but provision of such communications is a matter of time and money. It must, therefore, be admitted that as a practical proposition the immediate use of silver fir wood on a large scale for these purposes is out of the question, except perhaps in parts of Kashmir State.

A word of caution is also desirable regarding the use of Indian silver fir and spruce timbers for aeroplane work. It is true that in strength, lightness and elasticity these woods compare favourably with Sitka spruce : *but*—and it is a very large "but"—the knottiness of these Indian timbers makes them entirely unsuitable for aeroplane work ; even the most carefully selected pieces of wood have been rejected by the Royal Air Force on this account. Thus, though the problem is still being studied by the Forest Department, it is unlikely that large quantities of Indian silver fir and spruce will be available for such work.

R. PARNELL, I.F.S.

3rd August 1928. *Conservator of Forests,*
Western Circle, Punjab.

("*Indian Engineering*," *11th August 1928.*)

WOMAN EXPERT IN THE FOREST DEPARTMENT.

"The Indian Forestry Department has on its staff a woman expert, Miss J. T. Kingston, who received her training at the Cambridge Forestry School and in the United States. Her work on occasions takes her in wild and remote districts, seldom explored by Europeans. Though not yet 30, Miss Kingston has written a monograph on one aspect of forestry, which has

attracted attention in scientific circles." [" *New Zealand Auckland Herald*" *of 20th June 1928.*]

" Here with a Loaf of Bread beneath the Bough
A Flask of Wine, a Monograph—and Thou
Beside me singing in the Wilderness—
And Wilderness is Paradise enow."

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NOVEMBER 1928.

COMBATING MALARIA—A NEW WEAPON.

From the Philippine Islands comes news of a new advance in the battle against our arch-enemy malaria. Developed by the Rockefeller Foundation in co-operation with the Philippine Health Service the new weapon has been tested on plantations milling at the Del Carmen sugar centre since 1925. On one of these plantations, which previously had from 30 to 50 malarial cases in hospital continually, there is now, according to reports, "practically no hospitalization and the incidence of malaria is unimportant." Another plantation has, through eliminating malaria by the new method, made an annual saving in labour turnover of the equivalent of Rs. 35,000. On Mindoro Island which in ancient times bore a prosperous and thriving civilization and has since been reduced to a wilderness by the ravages of malaria, in the San Jose sugar area malaria has finally been brought under control. It is anticipated that quinine as a preventative may soon be dispensed with at San Jose.

The foregoing results have been obtained by the simple and inexpensive process of lightly dusting all streams and pools, where anopheles larvae are apt to be found, with a mixture of one part of Paris green with one hundred parts of ordinary road dust. So sensitive are mosquito larvae to Paris green that only an astonishingly small amount is lethal. It was found in the Rockefeller Foundation laboratory where *Anopheles minimus* larvae were

being cultivated that the mere presence of Paris green in the farthest corner of the room resulted in the death of the larvae.

If the Paris green mixture is as effective as reports indicate, it is well worth the attention of forest officers in India, whose greatest enemy is, in many localities, malaria. Its cheapness is a particularly attractive feature. The writer proposes to experiment with this method of malaria prevention in connection with his various forest development projects in Madras, and would like to learn the result of any similar experiment elsewhere. It may be that Paris green dusting is known and has already been tried in India, and if so the writer would be glad to hear the details.

J. KENNETH PEARCE, B.SC.F.,
Logging Engineer, Madras Forest Dept.

PUNJAB AND UNITED PROVINCES SAL SEEDLINGS.

In the *Indian Forester*, Vol. LI, plate 32, the growth of Burma and Assam teak under similar conditions in Assam is shown with the plants from local seed making a poor show compared with those from seed imported from Burma. The accompanying photographs (plates 40 and 41) show sal plants grown in the botanical experimental garden, Dehra Dun, from local seed and from seed collected in the Hoshiarpur district, Punjab, at the western limit of indigenous sal. The Punjab seed was sown on 1st July 1925 and the local seed on 3rd July 1925 and the photographs were taken on 9th October 1927, *i.e.*, after three growing seasons. Now at the end of a fourth growing season the best plants from the local seed are three times the height and four times the basal diameter of the best plants from Punjab seed. At the time these seeds were sown beds of sal seeds from Bihar and Orissa and Assam were also sown but the seeds deteriorated so much on the journey that only three of the former and one of the latter germinated and all were killed by frost the first winter.

It would be interesting if a similar experiment could be made in Hoshiarpur with local seed and seed imported from Dehra Dun

Photo. by Harswarup.

Shorea robusta from seed collected at Asarori, Dehra Dun.

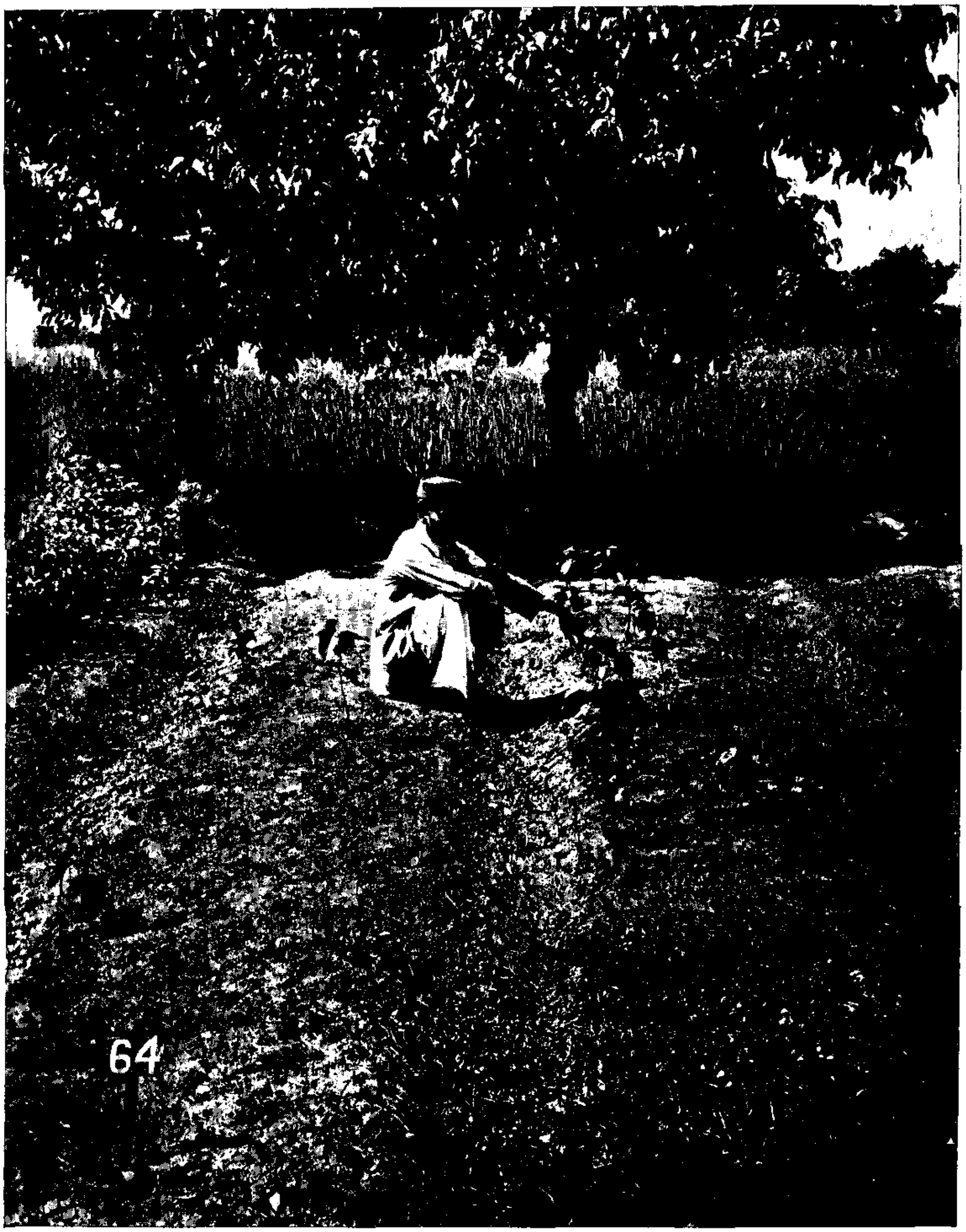

Photo. by Harswarup.

Shorea robusta from seed collected in Hoshiarpur, Punjab.

as it seems quite possible that in Hoshiarpur the sal has deteriorated by centuries of fellings bearing on the best of the stock and leaving the worst individuals to propagate the species. If this has not occurred one would expect local seed to prove superior under conditions in Hoshiarpur to that imported from Dehra Dun.

R. N. PARKER, I.F.S.,

Forest Botanist.

SAL AND ITS REGENERATION.

By F. C. Osmaston, I.F.S., Provincial Research Officer, Bihar and Orissa.

A.—Introduction.—In this paper on sal and its regeneration few or no new facts or theories are discussed but by laying more emphasis on some points and less on others it is hoped that fresh light will be thrown on the difficult problem of sal regeneration. The observations on which conclusions and arguments are based have been collected from tours in the majority of the Bihar and Orissa Forest Divisions and also from tours in the Dehra Dun and Saharanpur Divisions in the United Provinces.

B.—General remarks on sal seedlings and trees.—The sal is a very hardy and tolerant tree. It is found growing naturally, usually gregariously but also sporodically, over a large proportion of the Indian peninsula and in climates, soils and aspects that vary to a considerable degree. The annual rainfall may be as low as 35″ or it may be as high as 150″, although it is usually between 45″ and 80″. It grows in places where frost occurs annually and it is found where frost is unknown and where the daily maximum shade temperatures reach 120° F. It is found in moist fertile valleys and ravines, on gentle or steep hill slopes and also on the tops of dry rocky hills. It is found in areas where man hardly penetrates but it is also found where man cuts it, lops it, burns it and grazes his cattle, and even then it seems to thrive.

From these facts we are justified in calling the sal a hardy tree, a vigorous tree that defies competition and mal-treatment. Nevertheless, when we try to help it or invite it to regenerate we

find it extraordinarily perverse. Its seedlings persist in dying back not only for a few years but for a seemingly unlimited number, so that other unwanted species usurp its position. This is a seeming paradox. It would be excusable to conclude that the sal seedling is as hardy as its parent, especially on considering the great tenacity to life that young sal is known to have. But in this connection it must be remembered that sal has been ousted from large stretches of country by the very grazing, burning and lopping which it seems to resist so vigorously.

But the young sal seedling is not hardy. It is very tender, very susceptible to unsuitable conditions. This is shown by the colossal mortality that occurs in August and December to June after a good seed year and timely rains. But this delicacy of the yearling seedling is compensated largely by the tenacity to life that the two year old possess. If it can survive the first year it is fairly certain to persist indefinitely, strengthening slowly its precarious position, dying back annually but enlarging its rootstock, biding its time until conditions become favourable for growth or until it has strengthened itself sufficiently to overcome its difficulties.

If the forester can discover these unfavourable conditions he should then be able to alter them and so enable sal to regenerate itself securely.

C.—The conditions affecting sal seedlings.—Before discussing the factors, to which sal is susceptible, it must be remarked that they are all inter-dependent. Rarely can one be separated from the others, but each is decreased or increased in intensity by the greatness or smallness of the others. It is, therefore, difficult to classify these conditions, while measures introduced to modify them must be general and aimed at the correction of all injurious factors, although a measure that abolishes one factor may result in the abolishment of many.

The factors contributing to the health of sal seedling I classify below and each will be discussed in turn :—

1. The drainage of the sub-soil.
2. The texture, drainage and aeration of the surface soil.
3. The dead leaf layer.

Photo. by Harswarup.

Shorea robusta from seed collected at Asarori, Dehra Dun.

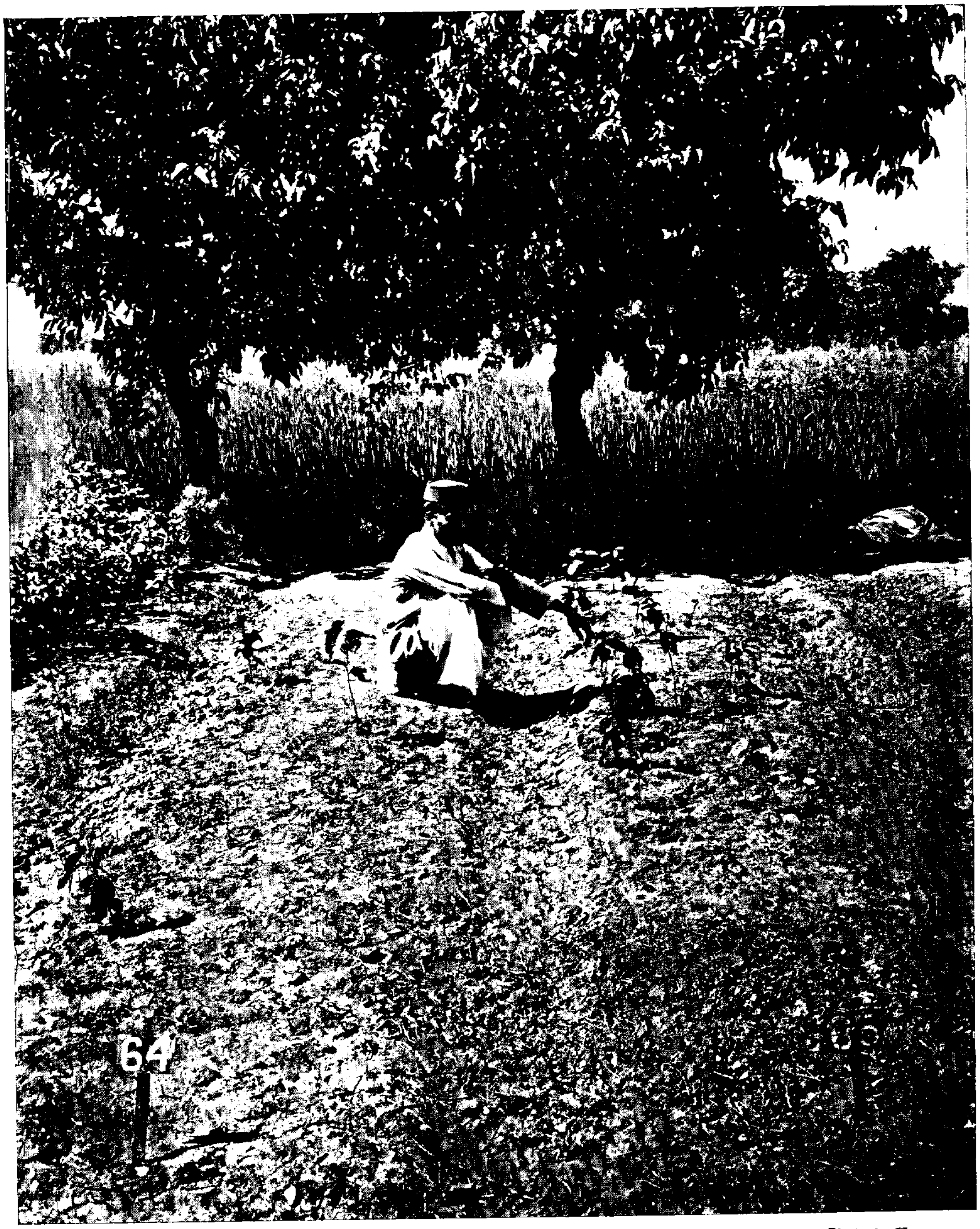

Photo. by Harswarup.

Shorea robusta from seed collected in Hoshiarpur, Punjab.

4. Shade.
5. Weed growth.
6. Soil moisture.

1. The drainage of the sub-soil.—The importance of sub-soil drainage to mature trees is shown by the fine growth of sal in well drained soil and by their stunted growth on impermeable clays. Its importance to seedlings is through the medium of the surface soil, since a well drained surface soil is impossible if the sub-soil is a clay and if the ground is flat. An impermeable pan would act similarly on seedlings and yet well grown sal trees might be found that had penetrated the pan, either by luck in finding a break in it or after a long struggle. Perhaps this would explain some of the instances where no regeneration is found under a well grown mature sal crop in seemingly favourable conditions. But a badly drained sub-soil would not affect a surface soil so greatly where the ground is sloping, because there the water could drain through the surface soil (if of good texture) and run along the sloping impermeable layer beneath into streams below. This explanation may explain sometimes why sal regeneration is absent on flat ground but present on a neighbouring slope.

But in importance sub-soil drainage is a secondary factor, since it is one that we cannot combat without great expense. Moreover, where there exists a healthy crop of mature sal it may be assumed that sub-soil drainage is good, since an impermeable pan that has been penetrated by the mature trees is unlikely to be common. Hence it will be disregarded in the remainder of this paper and good sub-soil drainage will be assumed to exist.

2. The texture, drainage and aeration of the surface soil.—I have taken soil texture, drainage and aeration together because they are so inter-dependant that their separation would be difficult. Moreover conditions affecting one affect the others, almost invariably. Also I would emphasize that it is my opinion that it is the state of the surface soil that has a greater effect than any other factor upon the establishment of a sal seedling ; other factors such as shade, soil moisture and weed growth would be

small problems if only suitable soil conditions could be obtained, as they would be overcome by the consequently vigorous sal.

The ideal surface soil is one that is loose and broken in texture for some distance below the surface and is consequently well drained and aerated. This can be produced artificially by hoeing or ploughing, and Bengal experience and Dehra Dun experiments have proved that sal seedings do not die back in such soils but grow into saplings without faltering. In the forest such growth is so rare that it can be said to be non-existent. Even if given full overhead light, seedlings always seem to die back (if they do not die altogether) or grow very slowly indeed, until thick rootstocks are formed. Now, in the forest a loose well aerated soil in the rains is rare, and its occurrence is affected by the following influences, all of which I consider to be very important to sal regeneration :—

(*i*) *Grazing*.—It is well known that grazing hardens the surface soil. If grazing is heavy the soil is trampled into a brick-like consistency and this consolidation continues for some distance below the surface. Moreover these conditions do not pass away after a few years but remain for some decades after grazing has ceased. The results are as follows :—

(*a*) It is difficult for the sal radicle and root system to penetrate the surface.

(*b*) Rain water cannot soak into the soil readily. Instead it runs off the surface so that the soil loses much of the water it should have and is washed into a still harder condition.

(*c*) The capillary ascent of water from below is hindered so that the surface layers of soil are much drier than they should be.

(*d*) Aeration of the soil is decreased. The gaseous space between soil particles in a consolidated soil is less than in a broken soil, nor can gases enter a hard surface as easily as a loose one. The resulting lack of oxygen in a hardened soil must be considerable and this is witnessed by the xerophytic type of vegetation that is commonly formed on heavily grazed land, even if it is situated in a moist locality.

It is well known that a lack of oxygen in a soil causes a physiological dryness that is similar in effect to a physical dryness caused by lack of water.

Consequently it may be concluded that grazing is entirely harmful to sal regeneration since it makes the soil hard, dry and deficient in oxygen. This conclusion is confirmed by the fact that seedlings or young sal regeneration are absent from land, which is being grazed or which has been grazed in the past. Also it may be assumed that it is the lack of oxygen that is primarily responsible for this absence of seedlings, since Hole has shown that sal seedlings are very sensitive to a deficiency of oxygen.

(*ii*) *Canopy.*—The canopy has probably a certain effect upon the hardness and resulting aeration of the soil. I have not yet been able to test completely my theories on this point by full observations. But in forests where there is an even aged canopy, where this canopy is at a considerable height and where there is little or no under-canopy or under-growth, I have noticed that the soil is often a little hard and probably badly aerated in consequence. I consider that this hardness may be due to the heavy drip from the tree crowns. In open country in India the ground is invariably hard, even where grazing is uncommon. Dryness accounts for some of this hardness, but I think that it is caused partly by the heavy impact of tropical rain. Even during the rains when the ground may be flooded, the soil surface is harder than that found in a temperate climate. In an even aged forest where the drip from the crowns is unbroken by undergrowth, the effect would be similar to that caused by heavy rains in the open.

Consequently, it is my opinion that an elevated even aged canopy with little or no under-growth is responsible for a certain amount of soil hardness (or rather compactness). This compactness hinders aeration greatly. Therefore an even aged canopy with no underwood may be considered to be deleterious to sal regeneration, and this conclusion is confirmed by the fact that it is usual to find no sal regeneration under a canopy that is even aged with little or no underwood.

On the other hand a loose textured soil is common in a forest where there are several age classes or where an overwood of sal

has an understory of other species (grazing being understood to have been absent for some decades), and regeneration in such forests is usually good.

In addition to causing soil hardness and lack of aeration, drip is likely to be harmful to the seedling itself. It is easy to imagine that a heavy drip from a height will hurt a young seedling, and it is known to damage some species, such as teak. The damage done to sal is not as heavy as with some other species, but there is probably some damage. That there is an influence hindering growth under an old and nearly even aged sal crop is shown by the usual scantiness of weed growth in such places. Often the intensity of light in these areas is not low and some other explanation, such as drip, must be taken as an explanation.

(*iii*) *Dead leaf layer*.—The leaf layer that accumulates during the hot weather is not likely to affect adversely either the soil texture or its drainage. In fact, as it decomposes into humus it improves both. But I am of the opinion that it does affect the aeration. At the break of the rains there is a layer of leaves some 3" or 4" thick lying on the ground. The rain welds these leaves into a thick blanket, and this matted blanket must prevent the access of air to the soil. This blanket effect of dead leaves is accentuated when the leaves are large and coriaceous in texture. Such leaves lie flat in layers, while smaller finer textured leaves tend to shrink into coils when dried and do not form such an impenetrable blanket. Then again this leaf layer decomposes rapidly just at the time when sal seeds are germinating. During the decomposition a certain quantity of carbon dioxide is formed and washed into the soil in the form of carbonic acid. Hole showed at Dehra Dun that carbon dioxide is inimical to sal seedlings and causes them to die back.

From the above arguments it can be seen that grazing, a dense canopy with no underwood (a light canopy nearly always does have an underwood, or at least an undergrowth), and a thick leaf layer in the hot weather and early rains, all combine to harden the soil or hinder its normal and healthy aeration and are, therefore, detrimental to sal regeneration. Moreover all these three factors can be regulated by suitable management.

3. The dead leaf layer.—It has been shown that a thick leaf layer affects adversely the aeration of the surface soil. In addition it prevents sal seedling roots from entering the mineral soil. Sal seed falls after the leaves and being light, rests and germinates on the top of the leaves. The leaves in the rains make a good seed bed and there is no inducement for the radicle and early root system to penetrate the soil. Instead it ramifies in the layer of leaves. At the end of the rains the seedling is left with a shallow spreading root system in the layer of humus or top two inches of mineral soil and soon succumbs to drought.

This is a well known phenomenon and can be tested by any-one in November in any sal forest. The mortality from the cause is extraordinarily heavy, but it is an evil that can be removed very easily by burning the leaf layer.

4. Shade.—Twenty or thirty years ago sal was considered to be a shade bearer, and this opinion was based upon the remarkable persistency of young sal under shade and upon its ability to push through and between the crowns of the undergrowth and under-wood. Recently, however, this impression has given place to a feeling that sal is a light demander, and this opinion has arisen because sal grows vigorously and strongly when given full over-head light. In fact it cannot develop fully without it. Moreover the fact that 'established' sal regeneration remains suppressed under shade and then shoots rapidly ahead on the removal of the canopy has favoured the opinion that sal is a light demander in youth as well. But the fact that sal seed germinates and sal seedlings persist and eventually establish themselves in dense shade remains, and indicates that sal can endure considerable shade in youth. Moreover, it is very doubtful whether an increase in light 'per se' will greatly help sal seedlings to become estab-lished. The perplexing variation in the presence of sal regener-ation in localities that differ widely from each other in shade intensity, the absence of regeneration in one place and its abun-dant presence in another place that has a similar shade intensity, suggest that shade in itself is a secondary factor and that some other more illusive factor is decisive. It is doubtful whether seeding fellings have induced sal regeneration anywhere. It is

certain that nowhere have seeding fellings induced healthy sa seedlings to appear in quantity where previously they did not exist. If light was an important influence on the establishment of sal regeneration, then sal should be an easy species to regenerate under the uniform system. The canopy would be kept dark so that little undergrowth could remain. A very light preparatory felling should then induce the shade bearing sal seedlings to appear, and, as they appeared, successive fellings should increase their number and size. The fact that this result is not obtainable is a certain indicator that shade is a secondary factor.

Shade, however, is of some importance. The dense low shade of evergreen weeds that spring up in damp places hinders and suppresses sal. But even then the more vigorous sal shoots penetrate the weeds slowly, although the weaker specimens and all seedlings and switchy sal shoots will remain suppressed indefinitely. Again, the type of shade appears to have an influence. Where small gaps occur in an uneven canopy it is commonly noticeable that sal regeneration is profuse, while in an even aged canopy with no under-story sal regeneration is often absent or scanty. This phenomenon has been discussed above when the suggestion was made that a heavy drip, whose fall was uninterrupted by a secondary underwood, is a hindrance to sal seedlings, probably owing to the deficiency of soil aeration so caused.

From these arguments it seems that only dense shade (such as that caused by evergreen weeds) can suppress sal, but that the type of canopy does have an influence and that an uneven canopy is the most suitable. Otherwise shade is a factor of secondary importance so that sal cannot be worked under the uniform system unless modified.

5. *Weed Growth.*—As might be expected the effect of weed-growth on sal regeneration varies with changes in the locality, but probably its ill effects have been exaggerated. In very dry places such as on steep rocky slopes weeds are valuable. They protect the soil against the full effect of the sun's heat and sal seedlings are often found enjoying their protection and slowly pushing through them. In regular even aged crops of sal a thin undergrowth of weeds and shrubs may be useful in preventing

soil consolidation caused by heavy drip from the sal crowns. Where sal regeneration is plentiful under an even aged canopy generally it is found growing under weed growth such as *Flemingia* spp., *Desmoidum* spp., *Indigofera* spp., *Woodfordia floribunda* and also among grasses. (But it may be wrong to suppose that sal is found in such places because of the weeds. The weeds may be only indicators of favourable soil conditions.)

In damp localities where weed growth is evergreen in character and gives a heavy shade and where weed growth is dense, weeds are an undoubted pest. In these conditions the shade is so dense, that it is possibly a primary factor in the non-existence or passivity of sal regeneration. The eradication of weeds is then of first importance. Besides giving extra shade a mass of weeds is toxic because it contributes a still thicker leaf layer then would be present otherwise, and this leaf layer being in deep shade and lying on a moist soil decomposes slowly and is likely to give rise to an acid humus.

In damp, fire-protected, reserved forests with a dense canopy, either regular or irregular in character, there is rarely any recent sal regeneration. This is commonly attributed to excessive shade. If the canopy is lightened weeds, that were suppressed and dormant before, inundate the area. Failure of sal regeneration is then attributed to weeds, and a thorough burning of the felling coupe is recommended to quell the weeds. But one burning will not do this. Now, I am not sure that the original absence of sal regeneration is due directly to shade entirely, but only indirectly. I have seen young sal growing in such shady places (*viz.*, under clumps of *Bambusa arundinacea*) that I hesitate to believe it. In these dense shady and damp forests the soil, though loose, is invariably black, and a black soil indicates an excessive quantity of humus. Such a soil is almost sure to be acid. So here again it is reasonable to suppose that the heavy leaf fall and accumulated humus is the primary cause for the absence of sal seedlings. If these acid conditions are removed by burning (not by opening the canopy which results in weed growth instead) sal regeneration should commence, and, if burning enables it to become established, it is likely to push through the weed growth that result from

the eventual final felling. Incidentally, it is likely that frequent burning will check the weed growth.

Even where established sal regeneration exists in moist forests weed growth is frequently a great nuisance and creates alarm. But sal regeneration that is really established (*i.e.*, having a thickness of, say, 1"—2" at the base of its frequently half dead main shoot) is very vigorous. Complete clearing of the coupe followed by burning in spring seems to check weeds a bit and then slowly the sal will push its way through. Frequent cleanings at this time will help sal but it is doubtful whether they are worth the cost.

From the above it can be seen that weeds are very noxious in damp forests, useful in dry forests, and probably useful in average forest where the canopy is regular. Therefore only in damp forests, need weeds be feared and there every effort should be made to reduce them.

6. *Soil Moisture.*—In what I have written previously reference has been made to moisture in various places. Where moisture is in excess there is danger of heavy vegetation, which acts both as a strong competitor to sal and as a hindrance to rapid humus decomposition. In other places moisture has been important only where the drainage of the soil is affected. Bad drainage causes bad aeration because excessive water occupies the interstices in the soil instead of air. This state may be compared to the bad aeration that exists in a consolidated soil where the interspaces are decreased in volume. Bad aeration and bad drainage result in a physiological dryness, as the plant is unable to use the moisture. But absence of moisture or physical dryness also affects sal regeneration, but only where the soil is very dry Such places are common on the tops of hills and on steep slopes where the soil is shallow or on a southerly aspect. In such places the problem is entirely different to any other discussed before, except where it was mentioned weeds were beneficial in such areas. Although the minimum water content necessary for a sal seedling to live is small (shown by Hole to be 7 per cent in sand and 10 per cent in clay), there are large areas in Bihar and Orissa where this physical dryness is the control-

ling factor in sal regeneration. Such areas do not contain pure sal as a rule. The crop is mixed but is always open, the sal is stunted and often hollow, while sal regeneration, never in masses but often scattered everywhere, seems tc be incapable of growth. But the problem of regeneration in these areas is not pressing. Such areas can never give good, dense or even pure sal. This is realised and these dry areas are worked gently with selection fellings. The only problem here is to conserve whatever moisture there is. To do this the soil must be kept loose to prevent, excessive desiccation by the sun.

The effect of soil moisture, therefore, is of importance where it is excessive or where it is in large defect. In the former instance the problem must be discussed under drainage, aeration or weed growth, and in the latter means of conserving, whatever moisture there is, must be discussed.

(*To be continued*).

NURSERY TREATMENT AND PLANTING OF EUCALYPTUS SPECIES

Since 1903 efforts have been made to grow Eucalyptus in Changa Manga Irrigated Plantation. On 18th August 1911, Mr, Coventry, then Deputy Conservator of Forests, formally proposed raising 30,000 plants annually to replace the gradually disappearing shisham *(Dalbergia Sissoo)* standards. This was considered "a perfectly prepostrous proposal" by the Conservator. Eucalyptus, however, was tried on a small scale and we have fine specimens of trees in compartment 60 and some in the Rest House compound. With the same object in view, Mr. Parker in his Working Plan (1916—1936) of Changa Manga suggested trying experiments with some of the species found in the Punjab plains.

2. In April 1925, Mr. Coventry obtained 500 seedlings of *Eucalyptus rudis* 4" to 6" in height from the Lawerence Gardens, Lahore, and transplanted them in Changa Manga in raised beds bricked up at the side. These grew to a height of 10'—15' by the following March. In March 1926 about 40 of these were planted

in the Range Office compound in the form of root and shoot cuttings. Of the remainder, 200 cuttings were planted in April 1926 in compartment 25.

3. This was very encouraging and in 1926 experiments were undertaken on a large scale and 30,000 bottomless pots (height 6", diameter 4" at the bottom and 6" at the top) were obtained. The pots were placed close together in beds of 100 pots each and filled with good humus soil. *Eucalyptus rudis, E. terecticornis, E. rostrata* and *E. siderophloia* seed was sown in March. The success obtained was in the order given.

4. Watering was done by means of water cans. For days no seed germinated. In the case of a few pots lying at the edge of a water-course, good germination was obtained and it was thus discovered that percolation was the correct method of watering. It was then found that individual beds were not level enough for irrigation by percolation. Germination was thus further delayed. It however continued as late as 15th May 1926 and eventually 12,000 pots were successful. On the average they contained 1 to 5 seedlings each, while a few had as many as 25 to start with. The number of pots was then increased to 18,198 by transplants. The transplanting was done in the morning under the shade of mulberry trees, close to the nursery, and the pots were returned to the beds after 4 to 7 days.

5. It was observed that 2" seedlings had developed 6" long root and that they did not stand the change, with the result that most of the transplants died. By the end of October 1926 the number of successful seedlings stood at 12,223 giving 41 per cent. success.

6. In April 1926 some of these bottomless pots, containing seedlings 4" to 6" in height, were transferred to the forest and placed 5' apart in 6" deep trenches dug 10' apart. As soon as the seedlings had established themselves, the earth in the pots was loosened and bottomless pots were pulled out so that they could be used again. The pots were similiarly removed from the nursery when the seedlings were 3' high.

7. The growth of the seedlings in the nursery was so vigorous that by 15th March 1927 they averaged 6' in height. As the

pots were placed close together in beds, a good many of the seedlings died through suppression while a good many more were not thick enough for root and shoot cuttings. Eventually 8,031 cuttings were obtained and planted among shisham and mulberry coppice in the regeneration area in April 1927.

8. In 1927-28 a more ambitious programme was taken in hand. *Eucalyptus tereticornis*, *E. rudis*, *E. rostrata*, *E. viminalis* and *E. macrocarpa* seed was sown in 60,000 pots in a nursery in compartment 8. The first three gave the best results. Irrigation again presented serious difficulties and early sowings failed to germinate altogether. A second and a third sowing was done and germination continued as late as June.

9. The beds were flooded once daily taking care that the pots were not submerged. It was discovered that a film of water entering through the pores of pots passed over the top layer of the soil leaving the seed absolutely dry. This gave the impression that water had risen through the soil in the pots. The distance between the ground surface and the seed bed in the pots was rather high and the water in the bed soaked into the ground long before it could rise to the seed bed and germination did not take place. To obviate this, water was allowed to flow into the beds gradually until it moistened the soil in the pot through and through. Beds were then watered, once only daily, until the seedling attained a height of 1½′ to 2′. Watering was then done once a week in summer and once a fortnight in winter.

10. In sowings carried out during April 1928 the pots were only half filled with earth. Moisture thus reached the seed in a shorter time. This gave better results.

11. The germination continued as late as June 1927 and 28,320 pots were stocked. Another 15,000 pots were stocked with transplants obtained from those containing several seedlings. This time transplanting was carried out at dusk for about two hours every evening and there were only 25 per cent. failures among them. The bottomless pots were pulled out as before when the seedings were about 3′ in height. By August 1927, there were 43,320 plants giving 72 per cent. success.

12. As a result of previous years' experience, the pots were so spaced that seedlings were one foot apart. Eventually in April

1928, 27,461 root and shoot cuttings were obtained and planted out in the forest 15′ apart among shisham cuttings. The remaining plants were not thick enough to form good root and shoot cuttings. A large number of the latter were transplants. This indicated that the spacing given was still defective. This year 1′—6″ × 1′ and 1′—6″ × 1′—6″ spacing is being tried.

13. The root and shoot cuttings planted in the Range Office compound in March 1926 are now 30′ to 35′ in height with an average girth of 13″ and a maximum of 19¾.″

14. Those planted in compartment 25 a month later measured on the average 12′—4″ in height, and 4″ in girth after one year. Every cutting had sent out 2 good shoots, of which one was removed at this stage. In July 1928 or after 26 months the average height was 30′ and girth 10·05″; the maximum girth being 17″.

15. The growth of seedlings transferred to the forest in pots at the same time, averaged 5′—6″ in height at the end of one year and in July 1928 (after 26 months) the average height was 29′ and average girth 9″. This compares very favourably with plants raised from root and shoot cuttings.

16. The root and shoot cuttings planted in the regeneration area in April 1927 among mulberry and shisham coppice have grown well. They are now 10′ to 12′ high.

17. Among the root and shoot cuttings planted in the forest in 1928, there were heavy casualties. These have been definitely traced to excessive heat during the dry months of April, May and June, and to a lesser extent to a defoliator, which made its appearance in the regeneration area this year. The supplies of irrigation water also were irregular this season and this may partly account for heavy failures.

18. The failures are being replaced by transferring bottomless pots with seedlings from the nursery. (Plate 42, fig. 3.)

19. It is significant that there was absolutely no failure in a dozen cuttings put in the Range Office compound in February this year. This indicates that early planting would be favourable but it is very difficult to carry out in practice in Changa Manga

Fig. 1.—26 months' old stand of Eucalyptus rudis.

Fig. 2.—Eucalyptus cuttings (14 months' old) growing along with shisham and mulberry coppice.

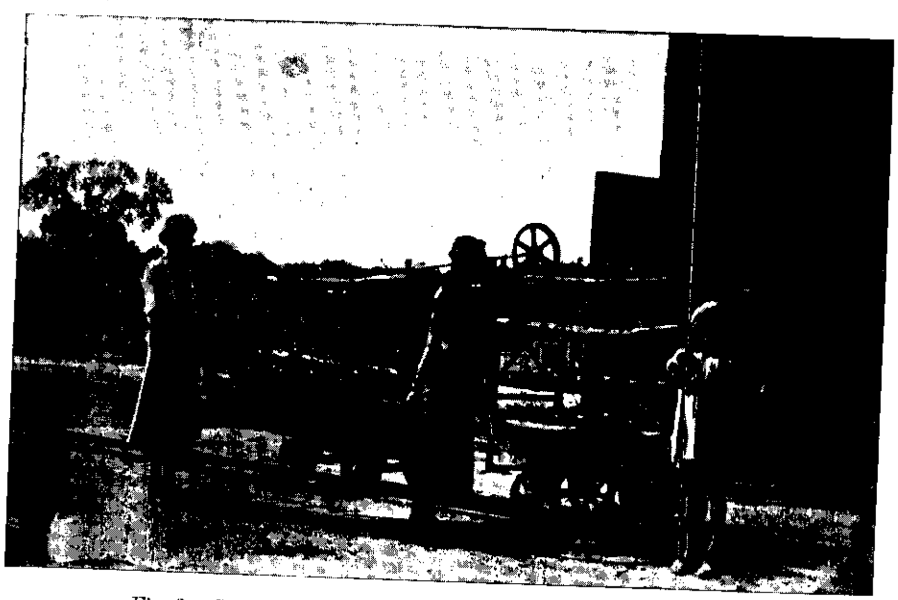

Fig. 3.—Seedlings in bottomless pots being sent out to the forest. On the right a boy shows bottomless pots.

as the irrigation season does not begin till 1st of April, thus cuttings cannot be planted out in the forest before that date.

20. Similarly sowings carried out in Daphar Irrigated Plantation in February 1928 gave cent per cent success, again indicating the advantage of early sowing. If water could be made available in February, Eucalyptus could be raised with greater success in Changa Manga.

21. Two nurseries would then be required so that while root and shoot cuttings of previous year's seedlings were being transferred to the forest from one nursery, the other could be got ready for sowings.

22. It has been observed that white ants badly attack all seedlings and cuttings grown in the new plantations in virgin soil; while in Changa Manga where all the sowing and planting had been done in humus soil, very few plants were killed by white ants.

23. Seed obtained from Lawerence Gardens and that collected locally from trees growing in Changa Manga did not give good results, although it was found handy after the first sowings had failed. Seed obtained from Australia (Andrew Murphy, Grand View, Woy Woy) gave the best results.

24. It would be premature to declare Eucalyptus a success in Changa Manga until the crop has passed through a whole rotation. Once, however, a fast growing tree like this is established and successfully introduced into the market, it should be possible to double the annual output of fuel and timber in Changa Manga or to reduce the rotation considerably.

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NOTE BY THE FOREST BOTANIST.

This article seems to record success with the growing of *Eucalyptus rudis* from "root and shoot" cuttings. This species is one of three mentioned by Maiden (Crit. Rev. Gen. Eucalyptus IV, p. 76) which throw out adventitious roots from the injured bark or from a wounded limb. It is, therefore, to be expected to respond to propagation by "root and shoot" cuttings.

All species of Eucalyptus cannot be grown by this method. In 1925 I tried root and shoot cuttings with *E. tereticornis* and *E. citriodora* and although every plant survived none of the former and only one of the latter shows any sign of eventually growing into a tree. The one exception now looks like a seedling 18 months old whereas it is actually over four years old. All the rest are no bigger than they were before the roots and shoots were cut back.

According to Australian opinion *E. rudis* is worthless for timber and only of use for fuel. As Eucalyptus is difficult to split, any *E. rudis* stands in Changa Manga should be felled before the billets require splitting. This will lead to complications in the management of the plantation.

E. rostrata may also be expected to succeed from root and shoot cuttings and it produces a valuable timber but requires to be converted green or there is much waste from splitting. If *E. rostrata* or *E. tereticornis* are ever sufficiently abundant in Changa Manga it will involve importing sawyers to deal with the outturn if they are to be used for timber or the erection of a small saw will. This, however, seems to be no objection to these species both of which have already been used for timber in the Punjab.

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Forest Botanist.

'HALF ROUND' SLEEPERS OF CHIR (PINUS LONGIFOLIA.)

The Forest Department owes a debt of gratitude to the Editor of the "Indian Forester" for the clear note of warning sounded in the editorial of the issue of August 1928, relating to the danger of wooden railway sleepers being replaced, *in toto,* by metal ones, in the near future.

The railway sleeper situation, as far as the Indian Forest Department is concerned, is indeed very serious at the present moment, because it is impossible, as things are at present, for any wooden sleeper in India to compete with metal sleepers, which can now be obtained at phenomenally low prices. The

seriousness of the situation may be gauged by the fact that in the past, about two million cubic feet of sal and an equal quantity of deodar (about half the annual outturn of about the two most valuable Indian timbers) have been taken annually by the Railways for sleepers. If this quantity of timber is thrown on the general market, it will result in a most deplorable slump in prices. This is no imaginary suggestion, but a very imminent probability.

The low price of metal sleepers may be a transient and passing feature, owing to the very bad slump in the iron market. But if metal sleepers can be obtained at the present low prices for a few years more, the Railways will probably go in for a wholesale 'metallization' of their roads. This will be nothing short of a calamity to the Forest Department, and even to the tax-payer.

One of the remedies to meet the situation was suggested in an article on 'Halfround Sleepers' by Mr. W. A. Bailey, in the issue for August 1928 of the "Indian Forester." It refers to the introduction of teak and sal 'halfrounds' for railway sleepers, after proper antiseptic treatment. Mr. Bailey roughly estimated (*vide* the last paragraph of the article) that if 'halfround' sections are accepted by the Railways, the output of teak and sal sleepers could probably be increased by 25 per cent., and that the price of such sleepers would come down to about two-thirds of the present price.

In the present note, it is proposed to deal with another and a still better remedy, to meet the present serious situation. This lies in the introduction of treated chir 'halfrounds'.

Practically, all the chir sleepers extracted to-day are from trees or logs varying in girth (inside the bark) from 5 feet to 8 feet, or 19 inches to 30 inches in diameter. In trees from 15 inches to 24 inches in diameter, sapwood* extends to nearly half the radial length; in those up to thirty inches in diameter, its width is about a third of the radius. Therefore, the volume of sapwood in the former trees is about 75 per cent. and that in the latter about 55 per cent.

* In sal the sapwood is in most cases only about an inch in width.

The present North Western Railway specification, limiting sapwood to 25 per cent. connotes, therefore, at once a waste of about 50 per cent. in the case of the logs 15 inches to 24 inches in diameter and about 30 per cent. in the larger-sized logs, assuming a theoretically 100 per cent. efficient conversion of the logs into sleepers. The wastage is actually much more during conversion owing to the insistence on a rectangular cross-section and other restrictions regarding the position of the pith, one broad face to be entirely of heart-wood and the orientation of annual rings.

Now, in view of the above considerations, to reduce the cost of a chir sleeper to a minimum, the following conditions must be complied with :—

(1) there should be no restriction of *any* kind on the percentage content or distribution of sapwood in a sleeper,

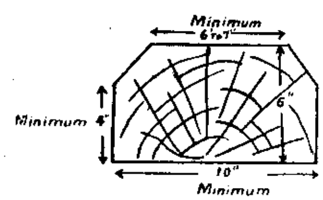
(2) the conversion of chir logs into sleepers must be as economical as possible. This means other sections, besides the rectangular, must be exploited.

The above two conditions must be satisfied consistent with the new sleeper, (obtained with no restriction on sapwood content and distribution, or even on the form of cross-section), being neither less strong, or stiff nor less durable than the one obtained to-day.

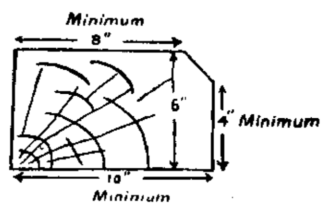
In this connection, it must be made clear that the restrictions on sapwood content and distribution, in vogue for the last 4 years, have been introduced by the North Western Railway owing to the difficulty in obtaining an efficient and economical treatment of chir sleepers with a large proportion of sapwood. As regards the strength of sapwood, data are available to show that sapwood is as strong as heartwood at the same moisture content, provided the wood is sound. The North Western Railway authorities, after over three years' experience, found that it was not possible to get a satisfactory penetration of the antiseptic into chir heartwood, using an economical quantity of oil, if the percentage of sapwood was over 25 per cent. Hence in their speci-

fication of 1927, they were constrained to reduce the sapwood content to 25 per cent.

Recently, as a result of research by the writer, the problem of treating chir sleepers with *any* proportion and distribution of sapwood has been solved, so that to-day, with about half the quantity of oil, a thorough and uniform impregnation in the *heartwood as well as sapwood* is obtained. Hence if the two following sections of sleepers, which have been in vogue for a number of years in Europe, are accepted by the Railways, a most economical utilization of chir logs will be effected, yielding the most serviceable wooden sleeper in the market; the price of a chir B. G. sleeper will come down to probably about Rs. 2-10-0 in the first instance, and eventually to Rs. 2-8-0 or even Rs. 2-6-0. The cost of treatment will be about Rs. 1-8-0, so that the cost of a treated sleeper will be about Rs. 4 as compared with about Rs. 6 to-day for a treated chir sleeper.



Section (a)



Section (b)

Complementary to (b)

This sleeper will be stronger and stiffer than the chir sleeper used to-day, and even the spike-pulling strength with a 6 inch dogspike will be obviously more than that using a 5 inch dogspike.

It will be obvious, from the above considerations and from past experimental and field data available at the Forest Research Institute, Dehra Dun, that there is no reason why treated chir sleepers of the two sections shown in this article should not give an average life of about 16 years, both from the strength and durability points of view.

Assuming a 16 years' life and the use of bearing plates, the annual economic cost* of the new chir sleepers, with bearing plates, will be Rs. 0·39 + Re. 0·088 or about Re. 0·48, assuming interest and amortisation at $4\frac{3}{4}$ per cent.

The annual economic cost of a steel sleeper, assuming an average life of thirty years and the purchase price of the sleeper, including freight, to be Rs. 8-8-0, is Re. 0·51.

From the above figures it will be seen that chir 'halfrounds' will be able to compete with metal sleepers even at to-day's prices. It is expected that about 7 or 8 lakhs of chir 'halfrounds' will be available in a few years.

If and when the new sections are accepted by the Railway Board, it is hoped that, at least in Northern and North Western India, wood will hold its own against metal, even at to-day's prices.

It is interesting to observe that it is estimated in Germany that the cost of maintenance of a steel sleeper track is roughly about 50 per cent. more than that of a wooden one. When the Forest Department can produce a sleeper which will be stronger and more durable than the present chir sleeper and will, from the annual economic cost point of view, compare favourably with metal sleepers, there is no reason why the Railway Board, and especially the North Western Railway, should not take as many of these sleepers as are available, as the wooden sleepers will be purchased from another department of the State, instead of the money going out of India as in the case of metal sleepers. It is hoped that the railways will recognise this point of view of the Forest Department, and will co-operate with the sister Department in recognising and accepting chir sleepers of the sections proposed in this note.

In conclusion, it may be of interest to readers to know that the North Western Railway are treating no less than eight and three quarter lakhs of coniferous sleepers, this year, in their wood preservation plant at Dhilwan, of which chir sleepers constitute about four lakhs. This fact alone is sufficient to show that

* Using the revised curve (May 1928), prepared by the Railway Board, relating to the Annual Economic Cost of Railway Sleepers.

they are satisfied with creosoted sleepers. Should they not be more than satisfied with the cheaper sleeper now proposed?

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[No responsibility can be accepted for the correctness of the figures or the conclusions arrived at in the foregoing article. The note is published as it contains useful information and raises a question, which may have a very important bearing on the commercial relationships between the Forest Department and the Railways.—*Ed.*)

NOTE ON THE SAL BORER ATTACK, 1927-28.

The sal borer attack continues in the sal forests of Supkhar and Baihar Ranges and operations on a large scale have been carried out in an effort to control its ravages.

As in the previous year, these operations have consisted in :—

(*a*) The felling, conversion, and burning of borer attacked trees.

(*b*) Trap tree operations.

Under the first head, work has been strictly confined to the felling of trees actually killed by the borer in order that the limited labour supply might be used to the best advantage. In last year's report it was remarked that much labour appeared to have been absorbed in the needless felling of trees only very lightly attacked. Such a tendency has been avoided in the year under review but even so it has not been found possible (at any rate in Supkhar Range) to deal with more than a small proportion of the heavily attacked trees.

The chief innovation in our control methods during the year, however, has been the actual catching and killing of the

beetles during the swarming period. As this interesting and novel operation has already formed the subject of a detailed note, extracts from this note may suitably be given here :—

"In 1927, on the suggestion of the Forest Entomologist, it was determined to carry out trap tree operations on a much larger scale and as an experimental measure to organize gangs not only for the burning of the attacked trees but also for the collecting and killing of the beetles themselves during the swarming period.

"No very thorough research work had yet been carried out to investigate the limit of the swarming period of the sal borer in the Central Provinces: such a research was essential in order to be able to verify with certainty the periods of the life history of the insect and to organize the control measures to be adopted in accordance with the knowledge thus gained: with this object in view the Assistant to the Entomologist, who was sent to the division, constructed an Insectary at Baihar. This consisted of a small-mesh-wire cage or room erected in the open air in the compound of the Baihar range quarters in which were collected, during the hot weather months, a large number of sal logs clearly heavily infested with the borer. The fact that the whole of the cage including the roof, was constructed of wire netting, allowed the logs to be exposed to the sun and rain and thus left them in climatic conditions closely approximating to those in the forest itself. An Assistant was placed in charge of this cage whose duty it was to enter it each day and to catch, count, classify as male or female and subsequently remove all beetles emerging during the previous 24 hours.

"The following are the most important facts disclosed by a study of the record of emergences in the Insectary :—

(*a*) The swarming period started on June 19th and the last beetles were caught on 27th July, *i.e.*, the swarming period lasted between five and six weeks.

(*b*) Swarming started on a day of very heavy rainfall (3·26 inches). It was heaviest during the middle of the swarming period, especially on July 6th and 7th following one inch of rain on July 5th.

(c) The total number of beetles caught was 193, of which 111 were male and 82 female. The proportion of males to females emerging was not markedly high or low at any part of the swarming period, *i.e.*, the proportion of males and females emerging was fairly uniform throughout."

Felling of Trap trees.—1st stage.—The felling of trap trees in the sal Ranges was started on July 19th immediately following the earliest rainfall of the monsoon. During the first fortnight of the operations, supervision and labour were principally concentrated on the felling of as many trees as possible, such trees being usually revisited after several days for the purpose of catching any beetles that might have been attracted to them. Trees chosen as trap trees were those whose removal was silviculturally desirable, but which at the same time had not been so seriously attacked by borers during the previous year as to render them an unattractive bait to the newly emerging flights of beetles. Trees of over 3′ girth were usually chosen, it being expected that large trees would prove more attractive than poles and saplings. During the first fortnight of the swarming period work was concentrated on the felling of trap trees in large numbers, the killing of beetles being only a subsidiary operation, trees being usually visited for beetle catching purposes a week after they had been felled.

Felling of Trap trees and catching of beetles.—2nd stage.—The Forest Entomologist accompanied the Divisional Forest Officer to visit the sal areas during the swarming period and they reached Baihar Range on July 5th. On their first visit to the jungle to inspect the work in progress, they were informed by a Baiga cooly under the influence of liquor that immediately on a tree being felled, the emerging beetles started to fly up to it and that in this way large numbers of beetles could be caught in one day on a single tree. His report was hardly taken seriously at first but during the course of the same morning it was found that this man had actually been the first to observe a phenomenon which would doubtless have been recorded very shortly afterwards as a result of research. Trap trees were felled in the presence of

the Forest Entomologist and the Divisional Forest Officer and it was found that within half an hour or even less of felling, the beetles started to fly up to the felled trees, first usually alighting on the surrounding undergrowth, from which they would pass to the fallen tree ; it was found that the cut ends of logs were special centres of attraction, the beetles collecting here to drink the oozing sap. There would thus appear to be little doubt that it is the smell of the freshly exposed sap which attracts the beetles to the newly felled trees.

During the course of this same day, beetles to the number of five or six hundred were collected and caught from a single tree, a very striking contrast to the average of 2 or 4 beetles per tree caught during the preceeding period : in the course of the following week cases occurred of more than a thousand beetles being killed on one tree during the first 24 hours after felling. It was found that during the second 24 hours after felling the beetles still continued to be attracted in large but diminishing numbers, but that after 48 hours had elapsed, the trap trees felled lost, to a great extent, their power of attraction, comparatively few beetles being caught as compared with the first 48 hours.

Method of felling.—As soon as it was found that newly felled trees were most attractive to the beetles, it was decided to keep the size of trees chosen as trap trees as low as possible in order to economise labour and expense. At the same time orders were issued that the number of trees felled was to be very considerably reduced, attention being concentrated rather on the catching of a maximum number of beetles than on the felling of a maximum number of trees; in consequence, whereas during the first fortnight of the attack, 13,000 trees were felled and 37,000 beetles killed, during the succeeding month, until the operations were ended, 6,000 trap trees were felled, resulting in the death of 383,000 beetles.

The most effective way of catching the beetles was found to consist in felling and logging the trap trees in the following manner: after felling, the branch wood of the tree was cut off and thrown on one side and the stem of the tree was cut off into a number of conveniently handled logs about 8′ in length. Such

logging exposed several cut ends in each tree and thus increased the attractive smell of the sap. The tree was then left and the coolies returned to it once or twice during the course of the next 24 hours in order to collect the beetles attracted to the logs. On their approach to the trap tree, the beetle collecting party would find that numbers of beetles were running about on the bark while the cut ends of the logs were often crowded with beetles drinking the sap. Hearing the coolies approaching, the beetles would hurriedly attempt to conceal themselves under the logs. Those failing to do so were rapidly collected while the remainder were caught by rolling over the logs and exposing the insects crouching beneath them. The beetles were killed by severing their heads from their bodies: the heads were collected in bags and taken back to camp in the evening to be counted. It was found that women and boys were more successful than men in catching the beetles.

During the fortnight starting July 10th, the beetles, continued to be caught in very large numbers but at the end of the month there was a sudden fall in the daily bag both in Baihar and Supkhar Range. The operations were eventually brought to a close on August 7th by which time the daily catch of beetles had greatly decreased. It was remarked towards the end of the swarming period that the proportion of female beetles killed had become much lower than was found to be the case earlier in the operations.

The total number of beetles caught in the whole operation was 408,000 and the number of trap trees felled was 18,600. The distribution between Ranges was as follows:—

Range.	No. of trap trees felled.	No. of beetles killed.	Average No. of beetles per tree.
Baihar ...	15,471	252,600	16
Supkhar ...	3,142	155,867	49

The reason for the much higher average in Supkhar Range was that a very large number of trap trees (11,000) were felled

in Baihar Range in the first stage of the attack when very few beetles were being collected. The average catch per tree would have been much higher if the most effective methods of catching the beetles had been known when the operations started, instead of three weeks later. I have little doubt that with a similar labour supply it should be possible next year to kill not less than a million beetles.

Disposal of the Trap tree material.—On the conclusion of the trap-tree felling and beetle catching on August 7th, the problem of the disposal of the 18,600 trap trees had to be taken in hand. Practically all the trap-trees had already been very heavily attacked and wood dust was being ejected. A rapid examination of the felled material showed that on August 7th nearly all the larvae were still working under the bark and few had as yet penetrated into the wood itself. Orders were therefore issued that barking should at once be started but that as soon as it was found that the larvae were entering the wood itself in any numbers the felled trees should be logged and stacked ready for burning. After only a few days' work it was found that barking was no longer effective and it has subsequently been observed that even in the case of trees barked early in August a number of larvae must have already entered the wood at the time of barking. In very few cases are the barked logs found to be completely free from the larvae. It is therefore necessary to draw the conclusion that the barking of trap-trees is ineffective and that all trap trees should be logged, stacked, and burnt, with the exception of large logs capable of yielding sleepers: these should be barked and arrangements made as rapidly as possible for their conversion.

FURTHER NOTE ON THE ATTACK DURING 1927-28.

Subsequent observations have confirmed the first impression that the beetle catching operations have formed an effective method of control and have considerably reduced the fresh attack in areas where the supply of labour was sufficient to render these operations intensive over limited areas. In inaccessible areas, on the other hand, where the labour supply is limited,

particularly between June—September, it cannot at present be maintained that any great success has been achieved. To illustrate this, it is only necessary to compare the respective areas of sal forest in Supkhar and Baihar Ranges and the number of beetles that were caught in each Range. Baihar Range Sal forest is made up of small stands of good quality forest, interspersed with frequent forest villages while the extensive Supkhar Range sal forests which are of distinctly inferior quality, are very sparsely populated and the labour supply available is exceedingly small.

Range.	Area of sal forest.	No. of beetles trapped.	Average No. of beetles trapped per acre.
Supkhar ...	35,621 acres.	1,55,867	4
Baihar ...	15,746 „	2,52,600	17

These figures show that beetle catching was about 4 times as intensive in Baihar as in Supkhar. At the same time, the previous attack in Baihar was very slight in most areas as compared with the attack in Supkhar Range and in certain compartments was almost negligible.

As might have been expected, therefore, the success of the operations has been far greater in Baihar Range than in Supkhar where the attack seems hardly to have diminished in severity. In Baihar, on the other hand, it can be said with confidence, that the beetle catching operations have attained marked success. During 1926-27, work was only partially carried out in two or three compartments out of 32 : during 1927-28, all freshly attacked trees have been felled, and converted or burnt in about half the compartments of the Range and there is every hope that before the rains break work will be completed in all but 3 or 4 compartments. A few subsequent late deaths have occurred in the areas worked over but I have little doubt that in Baihar Range the borer attack will be brought completely under control

during 1928-29 as a result of the second season of beetle catching and one more season of control felling operations. Approximately 31,000 trees had been felled and stacked by the end of March in Baihar Range. It is probable that another 10,000 trees will be dealt with before the rains while possibly 5,000 attacked trees will not be dealt with owing to shortage of time and labour. These 5,000 trees are found in adjacent compartments in which the attack is heavy: by carrying out intensive borer catching in these areas during the rains, it is hoped to avoid the danger of the attack spreading again into the less seriously affected areas. A rough estimate of the attacked trees in this Range (including past attacked trees capable of yielding sleepers) may be placed at 45,000 trees over an area of 15,000 acres, or an average of 3 trees per acre; 40,000 of these trees will probably have been dealt with before the rains.

In Supkhar Range, on the other hand, the attack cannot be said to have diminished. The area of sal forest is 35,000 acres and as the attack is at least 3 times as severe as in Baihar, where the area is only 15,000 acres, the number of attacked trees in Supkhar Range must be placed at about 200,000. Of these, about 20,000 had been dealt with by the end of March and a further 10,000 will be dealt with before the rains, leaving 170,000 infested trees to spread the attack next season. With the limited labour supply available it is difficult to see any prospect of bringing the attack under control for some years. We can only hope to work the better quality areas and endeavour to save them from complete destruction. Owing to the poor quality of many of the Supkhar sal areas little silvicultural work has ever been done in them with the result that unhealthy overmature trees abound everywhere which ought to have been felled years ago in the interest of healthy silviculture.

There is now no possibility of doubt that such unhealthy trees are the natural prey of the borer as the weakness of the sap flow gives inadequate protection. It is undoubtedly the presence of this overmature timber that has led to the deplorable severity of the borer attack in this Range. The beetle is

in its own drastic way removing trees which we ought to have felled ourselves many years ago.

H. C. WATTS, I. F. S.,
D. F. O., Balaghat, C. P.

THE TRAP-TREE METHOD.

Mr. Watts' testimony to the effectiveness of the trap-tree method of controlling *Hoplocerambyx* is supported by the experience of Mr. McDonald in the adjoining division of South Mandla. The reports of both officers are being printed in conjunction with Mr. Muir's history of the operations in South Mandla as a Forest Record. They are the more welcome as measures involving the putting of salt on the insects's tail or of crushing it between two hard surfaces more frequently inspire mirth than confidence.

Mr. Watts does not, however, refer to the cost of carrying out the operations nor compare their efficiency with that of the alternative method of destroying the beetles before they leave the attacked trees. A few data bearing on these points arise from experiments conducted by my field-parties in the affected forests in 1927.

1. Emergence period. Trap-tree operations must obviously be concentrated at and shortly after the period of greatest emergence of the beetles. This period has been studied at Dehra Dun over a series of years in order to correlate the rate of emergence with the quantity and distribution of monsoon rainfall. Emergence invariably begins with the first heavy fall of rain in June and thereafter is influenced by the volume and distribution of the rainfall and the number of days elapsing since the initial date of emergence. In Dehra Dun complete emergence is reached with 35 inches of rain after the 1st June and with the same quantity the minimum possible emergence is 90 per cent.; at no date is the variation from the mean percentage emerged more than ± 15 per cent. In Baihar, Balaghat, where the normal June-July precipitation is less than in Dehra Dun, 100 per cent. emergence was reached (in 1927) with 26 inches of rain.

Compared by calendar dates irrespective of climatic conditions the rate of emergence in Baihar (1927) was more rapid than the average rate but within the limits possible in Dehra Dun. Thus :—

Percentage of beetles emerged on ...	June 20	25	30	July 5	10	15	20
(*a*) Dehra Dun ...	0—20	1—30	2—60	5—70	15—80	35—90	45—95
(*b*) Baihar (1927) ...	2	15	30	50	70	88	93

There is therefore no fundamental difference in the life-cycle of *Hoplocerambyx* in the Central Provinces and in North West India. The commencement of trap-tree operations should not be delayed later than the end of June.

2. *Attractiveness of trap-trees.*—A newly felled sal tree is immediately attractive to *Hoplocerambyx*, the attractive factor being the odour of freshly exposed sap. The range of attraction has been proved experimentally to extend at least a quarter of a mile to the leeward and to be almost inoperative to the windward. Distant beetles approach upwind, the males preceeding the females. The attractiveness rapidly decreases during the first two or three days after felling, but exists in a diminished degree for at least three weeks; (observations were not carried on for a longer period). During this period the daily new arrivals of beetles vary between zero and 20 per cent. of the arrivals in the first 24 hours. That this is due to the diminished attractiveness of the trap-tree rather than to the reduction in the beetle population of the immediate neighbourhood was proved by felling new trap-trees alongside the old ones. The attractiveness of an exhausted trap-tree can be revived to a certain extent by cutting it into logs, or partially stripping the bark, or bruising the bark with the back of an axe. Of these methods the most effective is the first, apparently being that which releases the most fresh sap. For practical purposes the logging of a trap-tree on the 2nd or 3rd day after felling is equivalent to the felling of a new tree.

Attempts were made to fix the comparative values of large and small trees for beetle-collection purposes by logging trees of various girths so that the total areas of the cross-sections of the

cut ends exposed in each tree were approximately equal. The experiments clearly demonstrated that larger trees attract and retain more beetles per tree than smaller ones; in the case of trees 3′—0″ to 3′—6″ in girth the attractiveness is 3 to 4 times greater than that of trees round about 2′—0″ in girth. While the attractiveness of the latter is 3 times greater than that of trees 6 inches smaller in girth. In marking trap-trees which must necessarily be selected from the silviculturally useless types and generally smaller girth-classes this criterion could be used. From the aspect of labour in felling, and logging, of reduction in the total number of trees to locate and inspect and subsequently burn and of concentrating the catch it is more profitable to deal with the larger trees.

3. *Comparative efficiency of the bonfire method and the trap-tree method.*—To ascertain the number of beftles destroyed per tree by burning attacked trees in stacked bonfires, analyses were carried out in Balaghat and South Mandla forests in the hot weather of 1927. The number of beetles maturing and emerging was found to vary directly with the girth and bole-length of the tree and with the intensity of the attack. Without going into details the following figures illustrate the variation and range in the beetle population per tree:—

Girth B. H.	2—3 ft.	3—5 ft.	5 ft. & over.
Most intense type of fatal attack.	70	140	260
Average fatal attack...	40	80	230
Slight attack not fatal	10	25	50

As the majority of attacked trees are under five feet in girth and as a high proportion fall into the moderately attacked class even after exclusion of the slightly attacked or green trees it is probably correct to conclude that the average number of beetles destroyed per tree by the bonfire method is in the neighbourhood of a hundred. This figure is appreciably below the number of

beetles that can be caught per trap-tree under perfected methods. The procedure tried in Balaghat at the close of the 1927 season as Mr. Watts has recorded, yielded an average for the period of 60 beetles per tree (and these were trees of "low size"); while that in South Mandla based on later experiments yielded, according to Mr. McDonald's reports, 375 beetles per tree at the climax of the emergence period. Several hundreds of beetles per tree were also obtained by my field-parties.

As a means of destroying beetles, therefore, the trap-tree method is no less effective than the bonfire method and is the cheaper of the two if restricted to the period of high beetle abundance. On a girth basis of comparison the cost of felling, logging, stacking, and burning the average trap tree should be less than the cost of the same operations for the average attacked tree, but placing this at 4 annas in both cases, and the additional cost of collecting and destroying beetles at 1½ annas per 100, it is clear that the trap-tree method is justifiable economically so long as the average trap-tree yields 40 per cent more beetles than the average attacked tree.

4. *Recommended procedure.*—The ideal trap-tree is one of 3—4 feet girth, examined once only on the day following the felling; but for ordinary operations I suggest the most profitable procedure is as follows:—

1. Commence felling traps at the end of June or when 10 inches of rain is recorded (after the 1st June), whichever is the earlier.
2. Within the limits of 1′—6″ to 3′—6″ girth fell larger trees in preference to smaller.
3. Log the bole sufficiently to allow it to be rolled over.
4. Collect beetles on the first and third days after felling.
5. On the third day re-log the tree and partially strip the bark and collect beetles on the 4th day.
6. Thereafter leave the logs as a trap for eggs and burn in the cold weather.

5. Finally, reference may be made again to a belief, which is dying very hard, that if no control measures at all were used

against the borer an epidemic would subside naturally after all the unhealthy weakly resistant trees had been killed. This belief is sometimes supported with the assumption that *Hoplocerambyx* and the sal forest have always existed together and therefore the former will never destroy the latter.

The two following statements are literally true and are facts in so far as our limited knowledge of the physiology of sal allows us to observe:—(1) A perfectly healthy sal tree is able to resist the attack of *Hoplocerambyx* and (2) *Hoplocerambyx* is able to kill a perfectly healthy sal tree.

Each in its unelaborated and unqualified state may form the basis of an opposite school of thought. The qualifying factor is the ratio of *Hoplocerambyx* to sal. Given an infinite number of beetles *Shorea robusta* would disappear. It *has* disappeared in certain localities, where every tree, healthy and unhealthy, of all sizes and ages has been killed by an overwhelming attack of the pest. Given less than overwhelming numbers the beetle loses in an attack on a perfectly healthy tree; its eggs and larvae are entombed in floods of resin in the bark. The saving clauses which have perpetuated both tree and beetle are (1) the immunity to attack of the seedling, sapling and young pole stages, and (2) the limit imposed on the number of insects that can reach maturity in a single tree which bears no relation to the number of eggs laid on it, and (3) the production of breeding-material for the beetle when at its lowest ebb by causes other than its own efforts.

C. F. C. BEESON, I.F.S.,
Forest Entomologist.

TAPPING "HARDWICKIA PINNATA" FOR WOOD OIL.

The ghat reserves of South Kanara in the Madras Presidency contain *Hardwickia pinnata* trees in fairly large numbers. The lead to the coast is so great, about 70 miles, that this species has never been felled for timber in the South Mangalore Division.

Only stems of and above five feet girth at breast height may be tapped and the procedure is as follows:—

A hole three quarters of an inch in diameter is bored into the stem about three feet above ground by means of an auger. The hole should reach the pith and should be slightly slanting, with the pith-end a little higher than the bark-end. A lip is fixed immediately below the hole and a kerosene oil tin placed beneath the lip to catch the oil.

The oil, if thin, flows out entirely in one day and the tree should be visited, morning and evening, to see if the flow has ceased and the tin is full. When the flow stops the tin is removed and the hole is plugged tightly with a piece of wood. In the course of a year the hole is usually occluded.

Trees are tapped all the year round, except during the rains, from June to September. The tapping is done by local ryots in their slack season, their being no professional tappers ; though some are more experienced than others. Inexperienced tappers often bore a number of holes before they succeed in making the correct one, which will reach the pith.

A tree yields from one to four kerosene tins of oil, *i.e.*, from four to sixteen gallons and a tree yielding the most oil usually lives thin oil. Thick oil is better than thin oil and it is said that some trees do not yield any oil at all.

The right to tap for wood oil is leased to a contractor and the lease usually runs for two years at a time. Ahmed Beary of Elimale, Sullia, South Kanara, has been the contractor for a number of years. He supplies empty tins and augers to the ryots and the latter collect the oil and deliver it at Elimale, receiving up to Rs. 5 per tin. The contractor thus accumulates some 200 tins of oil per annum, which he takes to Mangalore and sells to local dealers at about Rs. 10 per tin.

The dealers, Messrs. Hajee M. Mohidin Abba and C. Mahmood, Bunder, Mangalore, sell the oil at from Rs. 12 to Rs. 14 per tin of four gallons.

The South Mangalore Division derives a revenue of Rs. 300 to Rs. 500 from this source at present and the industry is capable of expansion.

The oil is used locally as a wood preservative, wooden doors, windows, pillars, rafters, ceiling planks etc., being given a coat of this oil periodically. There is no export.

It is not known how soon a tree will yield oil after the first tapping, though it is believed that trees will be ready for tapping again after 10 to 15 years. It is also probable that certain trees die after being tapped, but I have seen a number of stems, that had been tapped a year or two previously with no apparent signs of ill health. It is also not known to what extent the wood of a tree deteriorates in quality as a result of tapping, as few trees have been felled.

K. G. BELLIAPPA, P.F.S.,
D. F. O. South Mangalore.

REVIEWS.

GROWTH AND YIELD OF CONIFERS IN GREAT BRITAIN.

FORESTRY COMMISSION BULLETIN NO. 10, 1928.

This is a much revised and extended edition of Bulletin No. 3, published in 1920. Seven species are dealt with, the tables for Scots pine, larch and spruce being unchanged, those for Douglas fir and Corsica pine extended to a higher age, that for Japanese larch revised and extended, and a first provisional table being added for Sitka spruce. The tables are based on 48 permanent sample plots and 1,118 temporary plots including 'sub-plots" which are only about 0·1 acre in extent and are worked up with simplified calculations (a single group) corresponding to the small number of trees.

Girth measurement is preferred to diameter, and quarter-girth volumes are retained in deference to British commercial practice though the limit of timber is based on diameter, being 3″ diameter over bark. Methods were checked by clear felling 20 temporary

plots and measuring up every tree, the highest deviation from calculated volume being 5 per cent. and deviations over 2½ per cent. rare. For the permanent plots, 4 were similarly dealt with and the greatest deviation was 1½ per cent.

There are a few points in which the procedure described differs from Indian practice and these may be examined with a view to profiting by the Commission's experience. Firstly there is a new classification of stems and scale of thinnings, compromises between the International scale of 1903, and Schotte's 1912 proposals. Unfortunately the classes of trees distinguished are not described or defined, and one is left to guess the dividing line between *dominant* and *co-dominant*, etc., but if this were known, the change will probably be accepted as an improvement. It is doubtful if the same can be said of the Thinning scale. It makes no real difference whether or not Grade A is omitted (as it is) as merely a cleaning, but it introduces confusion to adopt the name D Grade for a light crown thinning when it has long been in use in some quarters, *e.g.*, Swiss and Indian Forest Research Institutes, for what the Forestry Commission term C2, *i.e.*, the heaviest grade of ordinary or low thinnings; it is surely also unwise and illogical to use the letter symbols in this way inevitably implying that the relation of D to C is only an increase of intensity without difference of kind, the same as the relation of C to B. The fact that the light crown thinning amounts to a D low thinning in the main canopy and an A thinning in the lower crown strata (and so has been designated DA by Flury) is not sufficient justification.

Half the sample trees in each plot—selection trees in the upper middle part of the girth range—are stem-analysed and the age height curve obtained, (after slight adjustment to bring it to the actual mean height and age of the crop), used in determining the course of the curves by quality classes for the yield tables. This is a good but time-consuming practice. Separate sample trees are measured for thinnings, also a sound procedure.

Baur's method whether applied to height or volume is rejected for the determination of quality classes, as also is Cajander's forest type method, and the 'site-class' practice of American

foresters adopted. This is based on the mean height reached at a given age (here 50 years) with convenient 10′ steps from class to class, thus Quality Class I Scots pine includes all crops the mean height of which was 55′ to 65′ at 50 years. The basic data are the stem analysis height/age curves of all sample plots over 50 years old. This class is indifferently called Class I or the 60 ft. Class——we would prefer to see the latter definitely given the preference. Mean height age is calculated by Lorey's formula as at Dehra Dun and mean height is used instead of age in plotting crop volume, form factor, number of stems, etc., per acre, as curve drawing was found to be easier thus.

The usual difficulty in determining the volume of Intermediate Yields has not been allowed to be too troublesome, and ratios of the mean stem in main and intermediate crops, derived from continental yield tables, have been utilised for the purpose.

A chapter is devoted to comparing the tables with those of other countries. The case of Douglas fir is interesting as up to 50 years the growth exceeds anything recorded for America; the indications are that later on this rapid growth will fall off. The parallel is close to the case of *Pinus longifolia* grown at low elevations in India.

An appendix gives the essential data for all plots—three lines to each. There are 7 fairly well reproduced plates showing a sample plot of each species and a Bibliography of 37 titles.

The volume under review is yet another proof that forestry and forest research are really "getting a move-on" and those responsible for it deserve a full measure of credit.

NURSERY INVESTIGATIONS

BY H. M. STEVEN.

Forestry Commission Bulletin No. 11 (*1928*).

The Bulletin under review is the only record of the series to deal with silvicultural matters, six of its predecessors being concerned with insects and fungi and the rest with growth statistics It is a pleasure to review, for we have nothing but praise both for

the work which is recorded and the form in which it has been presented. Here is an account of important investigations carried out along adequate and accepted scientific lines. If one doubts the conclusions drawn, all the essential field data are here, and one can check the conclusions drawn from them or try to derive others in equal agreement with them. A series of 118 experiments are reported covering most of the range of problems which crop up in big scale nursery work—and that the Commission is working on a big scale is shown by the figures for coniferous plants put out annually, 4½ million in 1919-20 and 37¼ million in 1925-26. Incidently, it may be noted that *Pinus sylvestris* contributes 36 per cent. of the last total and non-indigenous species the whole of the remainder, and also that 95 per cent. of the area dealt with was stocked with transplants,-2 year—1 year stock being customary for pines, and-2 year—2 year for other species. The large figure of 729 acres of nursery, 76 per cent. of it actually under plants, is also noteworthy.

The present writer has recently had occasion to tabulate the essential points which must be observed in research on silvicultural problems, essentials which we have so commonly disregarded in India, and the account given in Chapter III shows that the work reaches the required standard on all points dealing with methods of investigation.

The following fourteen chapters deal each with one investigation carried out with one or more species and varying numbers of repetitions. An enumeration of the titles will show the extent of the work in hand :—

> Season of sowing : Treatment of seed : Method and density of sowing : Size of seed : Depth of sowing : Tilth : Weed problems : Summer shelter : Winter protection : Manuring : Season of transplanting (lining out) : Grading of seedlings : Spacing of transplants (lined-out) : Miscellaneous.

The investigations are of course carried out under conditions and with species different from ours in India, but there are points on which we can glean information worth our consideration ;

reference is invited to the chapters on tilth, depth of sowing, and manuring.

It is of interest also to note that the data of each experiment have been subjected to statistical analysis, standard errors having been calculated wherever the data allow, on lines (adopted from Fisher's book on *Statistical Methods for Research Workers*) varying with the form of the experiment and the resultant data, and simply explained in Appendix IV. The difference required to give a 20 to 1 probability is given in such cases; this is probably easier of comprehension by the non-mathematical reader than co-efficients of correlation.

A useful bibliography of 58 titles is also given on pp. 166—8.

That only a small beginning has been made on a very big field of work, will certainly be as well realised by the research officers of the Forestry Commission as by any outside critic. If the work is continued as it has begun, we may look to see British forest research soon taking the place it ought in comparison with other European countries, and we in India should try to follow the example set us, adapting methods to our particular requirements and striving to grapple with our special problems as well as the British staff has with British problems.

It is above all on the establishment of a really high standard of research that Dr. Steven and his collaborators are to be congratulated.

H. G. C.

LEHRBUCH DER THEORETISCHEN FORSTEINRICHTUNG.

(TEXT BOOK OF THEORETICAL FOREST MANAGEMENT,)

DR. C. WAGNER (FREIBURG), 1928.

This is a bulky volume of 330 pages. The author's excuse for its publication is that apart from the Management Section XV by Schupfer (219 pp.) in Weber's Manual of Forestry (1927), and Martin's Forest Management (1903), no new treatment of the subject has appeared this century. The revised (8th) edition by Neumeister of Judeich's classic treatise is apparently not counted. The book is somewhat differently and perhaps more logically arranged than its predecessors, under 5 main heads: fundmaental

principles in time and space, economic and technical organisation, and finally regulation of yield. There are 58 diagrams, etc., inset in the letter-press which serve fairly well to elucidate matters described in the text, some of them really too simple to require such diagrammatic representations, and one feels that the rather solid fare provided would be lightened by a few good photographic reproductions in the sections which permit of it, such as those on silvicultural systems and cutting series.

The two sections to which one looks with special interest are those dealing with normality, which is disposed of in 14 pages (pp. 88—102) and regulation of yield (pp. 259—331), but it cannot be noted that any particularly novel ideas are presented.

Towards the end of the book, we find an attempt to forecast the trend of development of yield regulation for the future. The 20th century so far is considered as being characterised by the establishment of Age-class methods and Increment methods, and it is predicted that the two will become combined or that increment methods on the lines of Biolley and Eberbach will come to the fore.

As so usual with German publications, works in other languages are completely ignored, but a new presentation of the subject from so authoritative a pen as Wagner's cannot but be of great value to foresters in all countries, and until we get something as comprehensive in English to supplement Schlich's Vol. III, we shall have to refer to the work under notice as the last word from the Continent.

H. G. C.

EXTRACTS.

GRANT OF PROTECTION TO THE MATCH INDUSTRY.

TARIFF BOARD'S RECOMMENDATIONS AND GOVERNMENT OF INDIA'S DECISIONS.

The report* of the Tariff Board regarding the grant of protection to the match industry has been published.

* The Report may be seen in the Commercial Library and Reading-Room at 1, Council House Street, Calcutta.

The Government of India accept the finding of the Board that the match industry in India fulfils the three conditions laid down by the Indian Fiscal Commission and should be protected. The Board recommend that the present duty of Rs. 1-8-0 per gross should be maintained and converted into a protective duty. The Government of India accept this recommendation and propose to introduce legislation during the coming session to give effect to this decision.

The Government of India agree with the Tariff Board that no limit should be fixed for the period of protection. They do not contemplate, however, the retention of the duty at the high rate of Rs. 1-8-0 per gross for any long period. This high rate of duty is necessitated mainly by the existence of an international combine with large financial resources and controlling the manufacture and sale of matches in a large part of the world, and partly by the preference displayed by the consumer for the imported article, a preference which should gradually diminish at the match made in India establishes its reputation. If its became evident that the Swedish Match Company had definitely adopted a policy of supplying the Indian market by matches made in India, and if it appeared that the prejudice against the Indian match, similar in quality to the imported match, was disappearing, the amount of duty would be open to reconsideration.

The Tariff Board consider that the manufacture of matches is not a fit industry for development on cottage lines, and cannot recommend any special measures for the encouragement of cottage match factories. The Government of India accept this finding.

The Tariff Board recognise that in certain circumstances an excise duty may properly be levied on matches manufactured in India, and the Government of India agree that conditions may arise rendering the imposition of such a duty desirable. They do not, however, contemplate the imposition of an excise duty at present.

The Government of India accept the finding of the Board that in present circumstances no action is called for against the Swedish Match Company on the ground of unfair competition. The Board recommend that, should developments indicate that

the Company is acquiring undue control to the detriment of the Indian industry, Government should take steps to safeguard this industry. The Government of India considered that if it appeared probable that the Swedish Match Company would obtain a monopoly of the manufacture and sale of matches in India, this would create a new situation which would necessitate a re-examination of the position. [Resolution No. 235-T. (24), dated the 1st September 1928, of the Government of India in the Department of Commerce] (*Indian Trade Journal, 6th September 1928.*)

MR. R. S. PEARSON, C.I.E., F.L.S.

Mr. Pearson who is in his fifty-fourth year, is the son of Col. G. F. Pearson, late officiating Inspector-General of Forests to the Government of India. "R. S." has spent much time in forestry and forestry research in India, and in May 1909, was appointed Forest Economist at the Forest Research Institute, Dehra Dun. During the war he was engaged in timber research work and served in the Indian Auxiliary Force, and soon after the end of hostilities was sent by the Government of India on a deputation to this country, the United States and Canada, to purchase equipment and to collect staff for the extension of the Economic Branch of the Forest Research Institute. Whilst at Dehra Dun he carried out, amongt other researches, much important work in the introduction of antiseptically treated sleepers, resulting in wood preservation plants by railways, and others, in the introduction of bamboo paper pulp. In 1927 he was appointed to his present position, in which I am sure, he will prove to be of considerable value to the nation. Britain's timber and Empire timbers are going to much more in the limelight in the future, and Mr. Pearson will find heaps of work to do. ('Timbericus').—(*Timber News, 24th August 1928.*)

TIMBER RESEARCH WORK.

PRINCES RISBOROUGH A SOUND NATIONAL INVESTMENT.

The very informal reception given last week by the Earl of Balfour and the Director, Mr. R. S. Pearson, C.I.E., F.L.S., to

about 140 scientific and business men who had been invited to witness the progress being made at the Forest Products Research Laboratory, Princes Risborough, was dealt with in part in our previous issue. We now continue the story.

In the Seasoning Section five kilns were in operation. These have already been described in the *Timber Trades Journal* (March 3rd, 10th and 17th). In addition, two small kiln ovens for experimental work were inspected by the visitors. These are used for drying experiments on the rarer timbers and are equipped with various commercial forms of recording thermometers and automatic controllers, in order that first hand information as to the operation of the instruments may be available for prospective users.

Considerable interest was taken in the charcoal kilns. It was stated that, far from being a declining industry, an enormous amount was imported every year, chiefly for paint and gun-powder. Three kilns were in action, two of a French type and a British—the "Tattersal." It was stated that the latter, which turns out about 800 lbs. of charcoal from 5,000 lbs. of wood débris, compares exceedingly well with continental types, and that the department had disposed of several tons of charcoal from it at a very satisfactory price.

The departments of Mycology and Wood Technology had a bewildering succession of exhibits of every kind imaginable. One interesting example was connected with "brash" in aeroplane spruce. By cultivating spores found in the timber it was conclusively proved that the rot was caused by a Canadian fungus, and that therefore the wood was infected before arrival in this country—and not after.

In the Woodworking Department experiments on the planing qualities of various timbers were being carried out. The respective resistance of each species to the tool is measured, as well as the degree of smoothness of the finished work.

To the timber merchants present probably the most important things to be inspected were the mill and log pond, which are

situated on the siding running up from Princes Rishorough Station to the drying kilns.

The three machines operating in the mill are of the latest pattern, and are housed in a large open-sided building on a concrete foundation. This building is connected with the log pond by a 5-ton travelling gantry, which can pick up the timber from the railway truck and deposit it on a platform by the saw-benches if required for immediate use. Special logs not required for some time are barked and submerged in the pond, where they can be readily identified by means of a numbered float.

The timber, on reaching the mill, is broken down into 2½in. planks on a 36in. horizontal frame saw. The horizontal type is preferred as, although rather slower in cutting, wastage is reduced to a minimum and great accuracy in cut is possible. The motive power for the saw, as for the others, is electric. The test, pieces are cut out on two push benches, 42in. and 86in. respectively.

Perhaps the only criticism one could make on the plant is that these benches do not appear to be long enough, with the result that extra labour is necessitated in holding up the timber as the cut nears its finish. Cross-cutting is done by means of a Wadkin 32in. pendulum saw and wood dust is removed by pneumatic means, the pipes being underground.

This system of exhaust ventilation has many advantages. It saves labour in cleaning up saw-dust and chips, diminishes the risk of accidents by flying particles of wood and keeps the atmosphere clear, thus enabling the worker to see properly and to breathe clear air.

Proceeding up the line from the mills a large number of hardwood logs were to be seen, these forming part of the Air Drying Section, and adjacent to them was a large model stack of Corsican pine planks.

One department which must not be overlooked is that devoted to " Records. " This, situated in the administrative block, is controlled by Major W. H. Lovegrove, to whose kindness and courtesy we are personally much indebted. It was through Major Lovegrove that we secured the excellent photograph reproduced

in last week's issue. The walls of the "Records Office" are gradually becoming lined with volumes of statistical and other information of an ever-increasing value and usefulness. The splendid method employed involves a very close combing out from every possible source of information—sometimes rather unlikely sources even—of facts of importance to the various departments of the timber business, from the seedling to the marketable product, and concerning both British and foreign grown woods, as well as of interest and value to the large army of scientists engaged in silviculture and timber research work generally.

The staff carry through a system of tabulating facts cognate to the subject, and these are all clearly indexed and filed away ready for easy reference at any time required. If one of the Laboratory's aims is to discover means of eliminating waste in timber, it is the aim of Major Lovegrove's department to prevent the waste of hardly-won knowledge of forest products.

In such a short space it is quite impossible to give more than a general idea of the work seen by the visitors to the Laboratory—work which goes on continuously six days a week throughout the year. With such a staff and plant there is not the slightest doubt that the Department of Scientific Research have laid out public money to the very best advantage: "Save timber and you will save a tree."—(*Timber Trades Journal, 11th August 1928.*)

PRIVATE AND STATE FORESTRY.

The position of private forestry in Great Britain was dealt with by Lord Clinton in an address delivered at the annual meeting of the Royal Scottish Arboricultural Society and published in a recent issue of the *Scottish Forestry Journal.* Lord Clinton pointed out that some 50,000 acres of woods had been felled during and immediately after the War, and that but a small proportion of this area had been replanted. "The causes," he said, "are quite easily seen. It is partly but not wholly, owing to the War. It is mainly due to penal taxation during the War and later, which has made

it impossible for many owners to replant their land....... It is very difficult indeed to get any exact estimate, for what they are worth, and it appears to us (the Forestry Commissioners) that there is being felled annually throughout the Kingdom a total of about 50 million cubic feet, representing perhaps 20,000 to 25,000 or even more acres, and we cannot ascertain that there is a larger area being planted than about 12,000 acres, obviously a quite insufficient replacement."

Lord Clinton anticipates that it is probable that the whole of the coniferous timber and almost the whole of the hardwoods (that is, broad-leaved species) now growing will have been felled by the end of next seventy years. There has been little planting of hardwoods for a long time ; many of the existing private woods have not been planted from the economic point of view, their *raison d'etre* having been either sport, amenity, or protection ; and the stocking, therefore, was in most cases very poor. If planting in one form or another is not carried on a greater scale, by the end of seventy years there will be a smaller area of woodlands in Great Britain than the 3,000,000 acres present in 1914. On the Continent, the State by no means owns the major part of the forested area, for example, Finland 43 per cent., Germany 25 per cent., and Sweden 20 per cent. only. The remaining forests are either held in communal ownership or belong to private persons; and both classes of owners receive certain assistance in remission of taxation and otherwise from the State, and have to obey certain laws and restrictions laid down on the subject of forest property.

Lord Clinton evidently does not think that forestry should be a purely State business in the future. Certainly the acts of the Forestry Commission themselves so far have given full cause for the belief—for they have mainly confined to afforesting new land by planting conifers to the entire neglect of hardwoods. Moreover, but small progress has been made with the important work of replanting the areas felled during the War. These, it may be admitted, are in private ownership ; but it should have been a first duty of a State forest department to devise some scheme under which these could have been reafforested at the earliest possible

date in order to preserve the valuable forest soil which had been built up by the former crop of trees. For such areas will yield a higher return under good management than new lands which are now being afforested after a long period of degradation. On one point many will be in agreement with the present chairman of the Forestry Commissioners. It is stated fairly in the following :—"I am not at all confident that the State can properly undertake the full duties of afforestation. I think the keenness of the general public—who in theory are very keen upon forestry—is likely to evaporate directly they begin to understand the great cost which will fall on them if the State shoulders the whole burden." This is a shrewd appreciation of the probable present position of public opinion in the matter, and would be endorsed by most forest officers who had had administrative experience in a properly organised forest service.—("*Nature*," *18th August, 1928*).

AFFORESTATION.

REPORT OF FORESTRY COMMISSIONERS.

The eighth annual report of the Forestry Commissioners for the year ended September 30th, 1927, has been published as a Parliamentary Paper by the Stationery Office (price 9*d.* net).

There has been no interruption in policy during the year, and the Commissioners' planting programme has been carried out in its essentials. Acquisitions during the year amounted to 36,039 acres, of which 30,755 were classified as plantable. The total area of plantable land acquired up to September 30th, 1927, amounts to 244,838 acres. This is 39,962 acres less than the proposed area. The area planted in conifers during the year was 21,963 acres, as compared with 23,300 acres under the Acland Programme, and 22,600 acres under the Commissioners' revised programme. The total to the end of the year was 90,156 acres, compared with 93,300 acres for the Acland Programme and 92,900 for the revised programme. Taking into account the area of land now available for planting and the probable course of acquisition for the next year, it is estimated that the Commissioners will

plant over the whole ten-year period approximately 135,000 acres of conifers, which will leave them 15,000 acres short of the 150,000-acres programme.

No definite progamme has been laid down for the planting of the board-leaved species, but during the 10-year period 4,133 acres have been planted, 1,510 acres being planted during the year under review. It is estimated that the total area which will be planted with hardwoods in the 10-year period will be approximately 5,000 acres. The total area planted up to September 30th, 1927 was 94,289 acres and this, added to the estimate for the remaining two years, gives a total of 140,000 acres for the 10-year period. The area proposed under the Acland Report to be afforested or replanted by local authorities and private owners with State assistance during the 10 years was 110,000 acres, or an average of 11,000 acres per annum. By means of grants, 41,861 acres have been planted, 20,571 acres have been prepared for planting and 9,254 acres have been cleared of scrub. Recipients of grants for "preparing for planting" undertook to plant up without payment of a further grant. The area planted will consequently exceed 62,000 acres.

The report estimates that the total area which will be planted by local authorities and private owners in the 10-year period with the assistance, in one form or another, of the Commissioners will be approximately 75,000 acres. The total addition to the woodland area of Great Britain was 18,159 acres, the remaining plantations being on the site of felled woodlands. In making these plantations and in beating-up the previous years' plantations, 45,342,000 trees were planted, of which 44 per cent. were Scots and Corsican pines, 26 per cent. Norway and Sitka spruces, 12 per cent. European and Japanese larches, and 10 per cent. Douglas fir.

In regard to the Forestry Fund, the report shows that, as compared with the previous year, changes are comparatively small. The total payments rose from £608,066 to £618,997, an increase of £10,931. The cost of forestry operations declined slightly from £451,124 to £450,854, but expenditure on forest workers' holdings increased from £63,939 to £73,354. Receipts rose from

£122,341 to £127,764, and net payments were therefore only £5,508 greater than in the previous year. During the year £82,138 was paid in respect of purchases of land, including the standing timber and buildings thereon, and £17,729 in respect of land held on long lease or feu.

A serious outbreak of pine sawfly in Rendlesham Forest was investigated, and it was found that the attack had been brought to an end by a bacterial disease which destroyed the caterpillars. The spraying of oak-seedlings and transplants against oak-leaf mildew had shown that this fungus can be successfully controlled. What is believed to be the first case of Dutch elm disease in this country was discovered in Hertfordshire. Immediate steps were taken to investigate the matter and a survey was carried out during the summer to determine the distribution of a needle-cast disease on Douglas fir.

Further investigations on the properties of home-grown, as compared with imported, pit-props were conducted in collaboration with the Forest Products Research Laboratory. A practical test was carried out in a group of coal-mines in South Wales with encouraging results. Progress was also made with the inquiries into the uses of small oak timber.—(*The Times.*)

CURE FOR SCORPION STING.

As I have recently seen it tried with the marked success, I think it is right to call attention to the fact that the root of *Achyranthes aspera* affords almost instantaneous relief from the pain caused by sting of a scorpion. The plant is very common everywhere. It produces one of those whose clinging burrs which are such a nuisance on one's legs when out shooting. It is called *chirchirra* by the people of these provinces. The root macerated in water is applied to the part stung. If this be done quickly, there is absolutely no pain half an hour or so after the sting instead of 12 to 24 hours of intense suffering which follow an untreated sting.

Few cases occurred in my village recently, in which the sufferers, thanks to *chirchirra* and the presence of a servant of

mine who knew how to apply it, were going about their work within an hour in each case, feeling nothing more than numbness in the part stung. I am aware that this is no new remedy, but its value cannot be too widely known.—(" *Pioneer,* " *25th August* 1928.)

FOREST MANAGEMENT.

WHAT IS AN EXPERT WORTH?

A large area of forest country in the vicinity of Wellington is controlled by the recently-constituted City and Suburban Water-Board. Much discussion has been aroused over the Board's proposal to offer a salary of £750 per annum for a foresty expert to guide its policy. Some members, and a large section of the public, think the suggested salary is too high.

At the Board's last meeting Mr. Troup (Mayor of Wellington) said that the determining factor as to the wisdom or otherwise of paying a salary of £750 would be what use the board was going to make of the forest. " If we are going to lock it up, as has been suggested, then, I say, we have no use for a forestry officer, but if we are going to follow the advice of the Government expert and make the best use of the forest, then I have no hesitation in recommending the board to pay the salary to the right man, if we can get him. I have doubts whether we shall be able to get the man we want."

Both the Director of Forestry, Captain Ellis, and one of his officers, Mr. Fail, said Mr. Troup, had resigned from the Government service to take up positions at salaries much higher than the board proposed to offer.

" If the forestry officer is to be employed merely to plant trees on vacant spaces," continued Mr. Troup, " then we can get along without a highly-paid man but if we are going to operate along modern lines, as outlined by the Director of Forestry, then we should have no hestiation in seeking such a man."

WHERE IS THE EXPERT?

Mr. P. Robertson (Mayor of Upper Hutt) said that he, too, had more doubts as to whether the board would be able to get the

right man at that salary than as to the price to be paid. Men were being trained in forestry work in New Zealand and were going afield to places where there was a better recognition of the services they could give. The board, he thought, would be extremely fortunate if it secured a man to do the work that was required. A man at £5 or £6 per week was not the man that was wanted; they needed a man of expert experience, who could advise the board soundly as to the best practices to follow, to bring a return from the forest area, while still placing the main aim of water supply and conservation first.

USE AND CONSERVE THE FOREST.

Mr. Troup said that no member of the board claimed to have any expert forestry knowledge, and, for his part he was going to be wholly at sea unless expert advice was available. He did not see how the board could proceed without such advice. "To lock this area up seems to me to be unthinkable," continued Mr. Troup, "because trees only decay after a time, and it is waste to allow a tree to waste away if profitable use can be made of it, safely and without harming in any way the main scheme of water supply. If good use can be made of the timber, then I see no reason why it should not be done, but we must be led by the advice of an expert, who has made this study a life's work."

POSSIBLE RELIEF WORK.

In order, however, that a beginning could be made, pending the appointment of a forest officer, the board decided that a report should be made as to such areas as could be planted, as a relief work, during the coming winter. At the same time an inquiry will be made as to the amount of firewood which could be taken out by relief workers.

* * * *

"New Zealand Life" would suggest to the Board that further advice be sought before they appoint a forester, seeing that such an appointment would be tantamount to acceptance of the policy of "working" the forests. The Board's first and greatest purpose is conservation, and they should take no risks with their valuable inheritance.—(*New Zealand Life.*)

ANIMAL LIFE IN INDIA.

PRESERVATION OF BIG GAME.

The following letter from Mr. Ameer Ali was awaiting publication in the office of "The Times" when the news was received of his sudden death on August 3rd :—

SIR,—The letter of the Vice-Presidents of the Society for the Preservation of the Fauna of the Empire, and the leading article in "The Times" of Saturday, July 21st, are most opportune.

The Indian sub-continent has a matchless fauna, but unless the public conscience is aroused and drastic measures are taken it is doomed to extinction, save in a few inaccessible localities within a very short period of time. No reasonable man desires to preserve animal life, tame or wild, at the expense of human beings.

THE ARMS RULES

Equally no person of ordinary intelligence and humanity can view with approval the indiscriminate destruction of game either for display or for profit. The widening in 1920 of the scope of the Indian Arms Rules ordinarily to permit any person or persons having a certain property qualification to possess and use arms has vastly increased the rate of slaughter either by armsholders themselves or by their employees for profit. Game laws and "close" seasons are set at naught. Local influence or collusion with underpaid forest or other subordinate employees of Government renders detection very unlikely. This destruction is now being widely carried into Government reserved forests, the last refuge of the large game of British India.

A GAME DEPARTMENT

The time has come when the creation of a Game Preservation Department for British India is absolutely necessary. Our African Colonies are models in this respect, and in certain territories the depredations of noxious wild animals, such as elephants

and lions, have been rapidly and satisfactorily checked by the local Game Preservation Departments dealing with offending herds or individual beasts, while not interfering with harmless ones. This is a far better system than the wider issue of gun licences on the borders of Government reserved forests for crop protection such as has been suggested by the Indian Agricultural Commission in its recent report.

Incidentally the ravages of game on crops in India are not nearly so marked as those of monkeys and domestic cattle in excess of human requirements, which are not confined to jungle areas but common to the whole of India. The indiscriminate diffusion of firearms will be apt to present even more cogent problems than these.

DYING OAK TREES.

FELLING IN FOREST OF DEAN.

Extensive felling of oak trees in the Forest of Dean has recently caused apprehension that the character of a beautiful woodland area is to be destroyed. The matter has been discussed by the Royal Forest of Dean Development Association, to whom it was reported that large sections of the forest were being denuded of trees which have long been features of interest and attraction. It is considered by the association that destruction of the distinctive character of the forest would be most serious, and if persisted in would leave parts of the woods as more or less devastated areas. At a meeting held a few days ago it was resolved that action should be taken to influence the authorities to change or moderate the scheme of clearance now being operated.

A correspondent in Lydney complains that "temporary sawmills have been set up in the centre of all the most famous valleys, and acres upon acres of spreading oak and beech trees have already fallen before the axe." "The clearances," he adds, "are on a wholesale scale in different parts of the forest, and it is feared that the entire 22,000 acres which comprise the forest are marked down for ultimate destruction."

Assurances were given at the offices of the Forestry Commission yesterday that fears concerning the attitude of the Commission to the Forest of Dean were groundless. The position, it was explained, was that oaks were dying all over the forest, and were rotting on the ground. Oak was planted over the coal measures, and the working of the coal had reduced the water table. Wells in the district were going dry, and the trees were being affected. There had also been bad attacks in recent years of tortrix—a caterpillar plague which had caused havoc in the South of England. The pest was known as the "oak leaf roller," and entomologists were so disturbed by its ravages that doubt had been expressed as to whether we could continue to grow oak.

The Forest of Dean, it was stated, was being systematically managed. This required a certain amount of cutting as trees reached maturity, but maturity had to be anticipated in the forest because the timber was going back so fast. Twenty per cent. of the trees cut were dead. When timber was taken to the mill hidden rot was disclosed. With regard to complaints of wholesale clearances the comment was made that fellings were actually below the normal number of the working plan of the Commission. Owing to the poor condition of the oak and the state of the market, they had not been able to sell enough timber to carry out the scheme arranged for the forest.

On the question of regeneration, an official said it was the definite policy of the Commission that where the soil was suitable for hardwood replanting of cut areas was to be with hardwoods. As stocks of hardwood were disappearing, the necessity was also realized of holding on to as much oak as the factor of deterioration would allow and as was consistent with present commitments and systematic regeneration.—(*The Times.*)

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FORTUNES FROM SABAI GRASS

The Vindhya plateaux of Bengal, Chota Nagpur and the Mirzapur District of the United Provinces contain extensive areas of shallow soil lands—they also exist very extensively in Bundelkhand and the Central Provinces.

During the past century extensive forest denudation has taken place throughout these parts of India for temporary cultivation or the forest has disappeared through exhaustion by over cutting.

After the forest is removed this type of land rapidly deteriorates to be unfit even for intermittent cultivation and it is particularly liable to erosion with the result that the top soil soon disappears and the rock is exposed.

An average type of land is, when the top soil consists of a *layer two feet deep, composed of ferruginous clays or loams* containing laterite, overlying rock.

In one District alone—Bankura—there are 624 square miles of shallow soil denuded lands now unfit for permanent cultivation.

The report of the Royal Commission on Agriculture refers to these lands and suggests that the afforestation methods of the United Provinces might be applied. At the moment the problem is being investigated by the Forest Department in Bengal but I doubt very much whether much of the denuded land could be

made productive of trees, owing to the shallowness of the top soil, without the expenditure of vast sums of money.

Mr. J. C. Nath, Assistant Conservator of Forests, who is in charge of the investigation in Western Bengal Districts drew my attention to the existence of a *sabai (Ischaemum angustifolium)* grass farm of 300 acres owned by a Bengali gentleman who was keeping his secret very quiet. On a recent tour this farm was visited and while wild horses would not extract any information from the local agent except that there was no money in the venture, I think the following particulars obtained by outside information of a reliable source may be of interest and especially to those Governments attempting to deal with erosion of similar denuded lands. The soil of the farm is typical of much of the land referred to; rainfall 50-60 inches, climate dry Western Bengal type. What struck one on seeing the farm is the complete cultural success of the venture, the whole farm of 300 acres is completely stocked with lines of *sabai* at intervals of 1′ × 2′.

There are two cuttings—one in November and one in April. The yield from the two crops amounts to approximately 40 maunds per acre, though a crop of 62 maunds was actually obtained in one 3 year old plot.

The actual method of raising the plants is exceedingly simple. The ground is ploughed and bunches of roots are dibbled in during June and July; they quickly take root and yield quite a substantial crop in the following November.

The actual cost of the roots—Rs. 40 per maund—is the most expensive item. To reduce this heavy cost a small area is first planted and in the next and following years the roots are divided. Annual tendings consist of ploughing between the lines and thinning out the grass clumps when they become congested; this is said to cost Rs. 5 per acre.

The grass raised on the farm averages 4-5 feet in length and being free from foreign matter realises a higher price than the jungle article. I understand that the owner of the concern in question has a contract with a certain jail for Rs. 4 per maund

for rope making. As however this may be an exceptional contract we can assume he would have got Rs. 2-8-0 at least even for paper making.

The actual cost of creating the concern is believed to be Rs. 60,000 but from this can be deducted Rs. 10,000 for mechanical implements now for sale and to be replaced by the country plough. The capital cost includes the cost of fencing godowns, presses, planting, plough cattle etc., the cost of fencing was high owing to there being 3 plots.

The following account gives, I believe, the financial result of the venture :—

Receipts.		Expenditure.	
	Rs.		Rs.
By sale of 40 maunds of grass @ Rs. 2-8 per maund (*see above*) from 300 acres ...	30,000	Cost of tending, including up-keep of plough cattle @ Rs. 5 per acre ...	1,500
		Cost of cutting, baling and delivery at Calcutta @ Re. 1 per maund ...	12,000
		Rent at annas 8 pies 4 per acre, depreciation, management charges etc., etc.	5,500
		Profit	11,000
	30,000		30.000

This shows a return of Rs. 22 per cent. on an investment of Rs. 50,000.

Already other venturers are making enquiries for land for *sabai* or have already started growing.

Considering the value of *sabai* for paper and the proximity of shallow lands from Calcutta there would appear to be great possibilities in this direction especially on loamy soils. It is understood that considerable areas have been planted with *sabai* grass in Bihar and Orissa.

CALCUTTA: E. BENSKIN,

12th September 1928. *Offg. Conservator of Forests, Bengal.*

AGRICULTURE AND FORESTRY IN INDIA.

The Royal Commission on Agriculture in India has published its report, with introduction, appendices, evidence etc. in thirty volumes, some of which have no less than 750 pages. The public will be lost in admiration of the industry, which has produced this mass of literature; but it may be expected that no one will ever read it all, any more than any one has ever read the whole of Spenser's Fairy Queen. On the whole the Report, from a forest point of view, is disappointing and we should have welcomed a more definite declaration that the Forest Department can very greatly assist the villagers, if allowed to do so. Nowhere in the Report do we find any realization of the fact that the officers of the Forest Department are more closely in touch with the more primitive agricultural races than the officers of any other department and yet this is undoubtedly the case in Bihar and Orissa, Burma, Madras, and elsewhere. Nor was any forest officer on the Commission, though we understand that it was proposed to appoint a forest officer to the new Council of Agricultural Research, although this Council consists of no less than thirty nine members. We wonder whether some of these will be as useful to the country as a forest officer would be. The Council is to be formed as follows:—

1 Chairman.

1 Eminent agricultural scientist.

1 Representative of animal husbandry.

1 Director of Pusa Institute.

1 " " Muktesar Institute.

1 Representative of minor administration.

1 Member of Council of State.

2 Members of the Legislative Assembly.

1 Representative of European business community.

1 " " Indian " "

3 Representatives of Indian Universities.

1 Representative of India Cotton Committee.

1 „ „ Planters Associations.

9 Directors of Agriculture.

9 „ „ Veterinary Services.

5 Non-official members nominated by the Govt. of India.

—

39 Total.

—

This imposing body is to meet twice yearly and it is believed that more frequent meetings would involve an undesirable degree of interference with the ordinary duties of most of the members. We are afraid that many of them will think that twice a year is double the proper number.

The recommendations of the Commission as regards forest are contained in twenty clauses.

Five of these deal with grazing and fodder grass and there is little to find fault with in their details, though there is nothing of outstanding importance to note. We believe that forest officers generally will agree, that it would be an excellent thing if the department numbered amongst its members certain officers, who had undergone special training with regard to the qualities of the various grasses, which ordinarily serve as the food of cattle either in the forests or when collected from the forests, and the methods of encouraging the best kinds and making good hay of them.

Some interesting notes on the subject are taken from the Report :—

" Grazing rights are extensive, as grazing is permitted over about 58,000 sq. miles out of the total area of 99,898 sq. miles of reserved forests, or, excluding Burma, over about 51,000 sq. miles out of 71,000 sq. miles. Some 6,500 sq. miles of protected forests out of a total area of 7,750 sq. miles are open to grazing, as are all the unclassed forests under departmental control. The number of animals grazed in the forests of the provinces chiefly affected, in

the year ending 31st March 1926, is shown in the Table below :—

Province.	Total number of livestock grazed in the forests, (in 000's)	Number of animals per *sq. mile of* forest lands administered by the Forest Department).	Total number of livestock in province, (in 000's).	Percentage grazing in the forests to total number.
Bombay	2,398	160	17,911	13·4
Central Provines and Berar ...	3,527	179	13,723	25·7
Madras	2,445	126	41,544	5·9
Punjab	3,275	489	25,273	13·0
United Provinces ...	1,065	204	41,473	2·6

"Complaints of definite damage to forests, as the result of permitting grazing in them, were made in the Punjab, in Bombay, and in certain areas of the Central and United Provinces. Elsewhere the Chief Conservators of Forests, who gave evidence before us, seemed satisfied that, on the whole, no material damage was being caused.

"There can, however, be no doubt that, both from the agricultural and forest point of view, the replacement of grazing by grass cutting would, in many instances, be an improvement........"

"An experiment, which the Forest Department in Bengal is making, is of interest in this connection. Grass cutting for stall feeding is encouraged by the levy of a merely nominal fee for the cutting of fodder and by the provision of cattle sheds surrounded by fenced exercise paddocks. This applies only to the hills. In the plains, the cattle are considered to be too inferior in quality to make a similar experiment worth while. Experiments of this character might well be made in other tracts in which conditions appear suitable.

"Whilst the fees charged for grazing vary greatly from *district to district and province to province, they are everywhere* low. For bullocks and cows the range is from one to twelve

annas per animal per year. A large increase in existing grazing fees is out of the question. Even a very moderate increase would be likely to arouse resentment and react unfavourably on those friendly relations between the people and the Forest Department which are essential, if forests are to be properly protected and utilised for the general benefit. Any drastic restriction of the number of cattle allowed to graze in a given area would also be open to the same objections. We can only state our conviction that it is desirable, in the interests both of forest conservancy and of cattle improvement, that the grazing of inferior cattle in the forests should be discouraged. In all cases the aim should be to secure a due proportion of grass cutting to grazing in each forest tract. Preference in regard to grazing should also, as far as practicable, be given to young stock and to animals of good quality. We recognise that this policy can only be carried out, if it has the support of popular opinion. We hope that that support will be forthcoming as the quality of the cultivator's cattle improves and he comes to realise that selective control of grazing exercised in favour of superior stock is essential to the promotion of improvement.

"Since it cannot be doubted that grazing in forests will, for a very long time to come, be an important feature of forest economy, we consider it essential that the intensity of grazing consistent both with the proper development of the forest and the preservation of desirable grasses should be determined as soon as possible.... ....'

"It is necessary to distinguish, at the outset, between the two quite distinct functions which forest lands fulfil in regard to fodder supplies. They act as fodder reserves in times of scarcity and famine and they are also sources from which many cultivators draw their annual supplies of fodder. It is, however, only for the cultivator living on the outskirts of forest lands or within a distance of not more than 15 or 20 miles from them that they fulfil the second of these functions. For the greater part of the forest area is, as we have seen, remote from cultivation and the limit is soon reached beyond which it becomes uneconomical for the cultivator to transport fodder by road or to have it brought to

him by rail. The Chief Conservator in the United Provinces informed us that the freight charges made it unprofitable to send even baled fodder more than 50 miles by rail. From experiments conducted by the Forest Department in the Central Provinces in 1912-13 it seems doubtful, indeed, whether the ordinary cultivator is, at present, willing to purchase fodder at all. He showed no disposition to take it when it was offered at four annas a maund which works out at under six pence a cwt. This fodder was offered at cost price....... . ...'

"Throughout periods of fodder famine, forests assist cultivators to maintain their livestock in two separate ways; grass is cut, pressed and baled for export to affected tracts and animals from these tracts are driven to the forests to graze there. In every season a small amount of hay is made in forest areas to supply such markets as exist locally, and in all provinces forest officers are most anxious to increase the demand for dried fodder, since grass-cutting is preferable to grazing from the point of view of forestry. Unfortunately the demand for dried grass is usually very small; thus dried fodder which forests might yield is largly wasted. Since forests are usually found in districts of heavy rainfall, and the local cultivators are neither numerous nor in need of fodder a large waste of grazing resources may often be inevitable. But much more use of forest grass might be made if cultivators were convinced of the need for feeding their cattle better than they now do; for, as has been pointed out in Chapter VII, dried grass is commonly regarded by cultivators as being a fodder only to be used in times of scarcity. The result is that, partly because cultivators are unwilling to purchase dried grass, or even to cut it themselves, and partly because forests are so often far removed from tillage areas, a great demand arises only in famine years. The demand is then met, so far as the grass crop of the year can be made to meet it, for very little hay is stored as a famine reserve. As hay, when properly thatched, will keep sound in stacks for several years, the question of accumulating a large stock against famine periods has often arisen. The Bombay Forest Department has given special attention to this subject and their aim is now to be able to supply about 20,000 tons in

a year of scarcity. With this object in view, about 4,500 tons of hay are made annually, and when a sufficient stock has been accumulated, the surplus is sold. Unless there is scarcity even the small quantity annually offered for sale meets with a poor demand and losses of from Rs. 8 to Rs. 10 per ton may be incurred on the amount sold. The 20,000 tons of hay available in a famine year would, if used to supplement existing resources, maintain life in some 40,000 to 60,000 cattle, and would thus be of much use, if one or two districts only suffered from famine, but would afford little protection to a precarious tract in which cattle were numbered by the million.

"As a general measure for famine relief, the storage of hay would only be a practicable measure if the demand in normal years were such that very much larger quantities of hay than are at present made in the forests could be marketed annually at prices approximately covering the cost of production.

"Apart from physical difficulties imposed by distance and cost of transport, the great obstacle to be surmounted is the attitude of the average cultivator to his livestock. This subject we have dealt with elsewhere; our immediate object is to point out its bearing on famine protection measures."

We believe that most forest officers will agree, that, if villagers could be induced to make hay properly, to drive their cattle for grazing to various parts of the forests in rotation, and to give up keeping thousands of useless cattle, the difficult problems connected with grazing in India would be more easily solved.

(*To be continued.*)

SAL AND ITS REGENERATION.

By F. C. Osmaston, I.F.S., Provincial Research Officer, Bihar and Orissa.

(Continued from pp. 567—577, November number).

Part II.

D. Established Sal Regeneration.—Before discussing the measures likely to ensure sal regeneration, it is necessary

to see what is the ideal type of regeneration to have. It is well known that it is useless to expect sal seedlings to 'go ahead' when overhead cover is removed. Small sal seed lings will continue to grow slowly or even remain as they are while grass, other weeds and climbers will take possession of the ground. It is necessary to have established regeneration on the ground *before* regeneration fellings are made. This means that in the Uniform or any similar system, established regeneration must be obtained in Periodic Block II or 20 years before it is actually required. Then the overwood can be clear felled, the remaining vegetation cut back and all refuse burnt. Coppicing established sal regeneration, whether just established, or more than established, acts as a stimulus. Burning too, may act as a stimulus but anyhow it removes much danger of subsequent fires, reduces the danger of insect epidemics and tends to check the growth of evergreen weeds. This method is known to result in excellent even aged crops of sal. But for its success established sal regeneration must be present at the time of the main felling. If the Uniform or any allied system is used, therefore, the whole problem is to obtain regeneration before 'regeneration' fellings commence.

It must be decided what established regeneration is. Seedlings or whippy single shoots with a thin rootstock will not shoot up immediately. The deciding factor is the thickness of the rootstock, and this should not be less than the thickness of a man's thumb. Preferably it should be larger. In my opinion, the ideal established sal regeneration is a sapling whose base is about $\frac{3}{4}''$ diameter and up to $2''$ diameter. It does not matter in the least whether it is suppressed or free, whether mis-shapen or straight, diseased or sound. At the time of regeneration it will be cut down and a new shoot will be produced from below the ground level. Established regeneration, therefore, may be taken to be sal shoots varying in size from a whippy multiple sprout whose rootstock is as thick as a man's thumb, to a sapling with a basal diameter of 4 inches.

(*Note.*—In cutting back operations it has been proved in the United Provinces by experiment that the stool need not be shaped, but the cut should be about 3″—5″ above ground level not flush with the ground).

E.—Measures and conditions necessary to obtain sal regeneration.—It is now necessary to decide what are the ideal conditions for sal regeneration and what practical measures can be used to induce it. Previously I have discussed the factors that affect regeneration, and I have laid emphasis on those that seem the most important. It is necessary to summarize the conditions and their causative factors.

1. *Soil Hardness.*—This is very important. It is caused by grazing and also by drip from a high regular canopy uninterrupted by a lower canopy. This drip will be aggravated by trees with large leaves.

2. *Bad soil aeration.*—This is also very important indeed. It is caused by soil hardness (*i.e.*, by grazing and 'drip'), excessive humus that decomposes slowly (aggravated by evergreen weeds and dampness), and by a thick layer of large coriaceous leaves.

3. *A thick Leaf Layer.*—This is also important. It is obviously caused by a dense canopy and is most injurious when composed of thick large coriaceous leaves (such as those of sal).

4. *Weeds.*—Weed growth is common in damp areas but is encouraged greatly by an open canopy and fire protection.

From this summary it is obvious that certain states have to be avoided. These are grazing, a regular one storied crop (particularly where conditions are moist), a heavy leaf layer, an open canopy and weeds. Also it seems that trees with large coriaceous leaves should be avoided. But sal is one itself, so one is lead to favour a mixed crop in which the other species have leaves that are neither coriaceous nor big. Some of the factors are contradictory. For instance, an open canopy is to be avoided because it encourages weeds, while a dense canopy produces a heavy leaf fall and should be avoided too. In this case the canopy must be kept dense and the leaves removed, say by fire.

Consequently, from a regeneration point of view the ideal forest would be one in which there was no grazing, in which the crop was mixed and the trees uneven aged, and in which ground fires occurred from time to time. It is noticeable that these are the conditions which obtained over large tracts in virgin forests where the population and consequent grazing was small and before the forests were reserved and fire protected.

D. Measures for improving the management of sal forests.—It is generally recognised that the scattered fellings necessitated by the uneven aged crops and scattered age classes of a virgin type of forest are uneconomical. If fellings are concentrated entirely in one place so that the overwood can be clear felled, it is generally acknowledged that the maximum economic advantages are obtained. But often it happens that regeneration is most certain in an irregular type of forest and least certain in an even aged forest. Then it is the duty of the forester to strike a balance between these two extremes so that neither are economic advantages lost nor regeneration sacrificed.

With sal there seem to be two ways of obtaining a reasonable balance. In one an uneven aged crop is maintained in order to ensure regeneration, but the Felling Cycle, which governs the length of time in which work covers one unit, is kept long in order that the work may be concentrated in an area of reasonable size. In the other method an even aged crop is maintained but pure sal is avoided and an understorey of other trees encouraged. This may be called "The Sal Uniform System." In both methods the leaf layer will be burnt frequently for some years before regeneration is actually required. Grazing should be prohibited.

1. *The Sal Uniform System.*—In this system an even aged crop is maintained for its economic advantages while special means are employed to ensure regeneration. The Uniform System or rather the Conversion System which is designed to cover the period between the Selection Fellings of the past and the Uniform System of the future, has been introduced already. This Conversion System is well known and its details I will not

repeat here. Its drawbacks are also known but I will repeat them :—

1. The Preparatory or Seeding Fellings designed to induce sal regeneration, where it does not exist, do not prove successful.

2. Where established regeneration does exist, or exists in patches, the subsequent final removal of the overwood causes damage.

3. The concentration of felling debris constitutes a grave menace. It affords an ideal breeding ground for a number of insect pests that are known and possibly of fungoid pests that are unknown. Also a subsequent fire would be greatly intensified.

4. In damp areas where sal regeneration is not very vigorous the preparatory or seeding fellings, whether light or heavy, result in a weed and climber growth that is more vigorous than the young sal.

By far the most important of these is the non-inducement of regeneration in areas where it did not previously exist. Excessive weed growth is perhaps the next important, but if the first difficulty can be overcome the others are secondary in importance. If established sal regeneration can be obtained in areas before they are due to be regenerated the naturally great vigour of sal combined with simple cultural measures will overcome the other difficulties.

It has been shown that grazing, an even aged crop, a pure species with a large coriaceous leaf, the absence of an understorey, a heavy layer of dead leaves and, possibly, suppressed or dormant weeds and climbers are the main enemies of natural regeneration. To overcome these enemies certain measures will have to be executed. Some of them will entail a general policy throughout the rotation, while others will be limited to certain periods of the rotation.

1. *Measures continuing throughout the Rotation.*

(*a*) *The encouragement of a mixed crop.*—A pure crop of sal should be avoided and a mixture of other species such as, *asan* (*Terminalia tomantosa*), *jamun* (*Eugenia*

Jambolana), *bija* (*Pterocarpus Marsupium*) and *karam* (*Adina cordifolia*) encouraged. It is generally acknowledged that pure crops of any species fatigue the soil, decreasing its fertility (anyhow for that species) and hindering natural regeneration. In India sal regeneration can often be seen establishing itself under trees such as *jamun* and *asan*. Both of these trees are capable of growing in badly aerated soil and are then the forerunners of other species which are able to come after the soil has been improved by the *asan* or *jamun*. Consequently, even if some of the trees in a mixed crop are not so valuable as sal, their presence is likely to be sufficiently important silviculturally to justify their retention. Moreover, the value of trees such as *asan* or *jamun* is likely to increase considerably in the future.

(*b*) *The encouragement of an understorey.*—The cultivation of light undergrowth and understorey will decrease the ill effects of a completely even aged canopy. The dangers of a heavy drip is lessened so that the surface soil is kept looser and seedlings are better protected. Also an understorey will tend to suppress or prevent the entry of grasses which are thought by some to have a toxic effect upon sal seedlings.

As long as the shade given by the understorey is not too intense, it is immaterial what form it takes. Preferably it should not be too close to the ground as is *Flemingia Chappar*. Being taller and more sparse *Flemingia congesta* is preferable as an undergrowth, while *Indigofera pulchella* and certain species of *Desmodium* are also valuable. Shrubs such as *Woodfordia floribunda*, *Wendlandia tinctoria* and *Mallotus philippinensis* and suppressed saplings of *asan*, *bija*, *dhaura* (*Anogeissus latifolia*), *karam* and *jamun* are likely to be very useful. In fact the cultivation of *jamun* as an understorey where possible on similar lines to the cultivation of beech in Europe may be most beneficial.

(*c*) *Prohibition of Grazing.*—As shown previously grazing is harmful to regeneration and should be prevented throughout the rotation wherever possible. It is most unlikely that regeneration will succeed in any area where grazing has been heavy within the previous thirty or even forty years.

2. *Measures confined to the second half of the rotation.*—It has been emphasised above that it is very doubtful whether regeneration fellings will induce sal regeneration. This statement should, perhaps, be slightly modified. Unless soil conditions are favourable, regeneration will not be induced by regeneration fellings. Also it has been emphasised that if soil conditions are favourable sal regeneration is likely to appear even when no fellings are made. Even if these statements are not accepted it is obvious that many difficulties will be overcome if soil conditions are brought to the *optimum* before the end of the rotation, If possible, sal regeneration in an established state should be present before the end of the rotation.

To obtain these optimum conditions there are two factors with which to contend—excessive weed growth in damp areas and an excessive dead leaf layer. The removal or suppression of both these can be affected by periodic ground fires :–

(*a*) *Burning to remove weed growth.*—Weed growth is only dangerous in valleys or in areas where the average relative humidity is high and the soil good. Now ground fires will not check evergreen weeds at once. Therefore ground fires should be started some 30 years before the end of the rotation, *i.e.* while in P. B. III. The exact time will depend on the intensity of the weed growth. The areas should be burnt annually with these ground fires. Fire protection is known to favour evergreen weeds; burning should discourage them. This burning should reduce weeds to reasonable proportions so that those remaining will not prevent sal seedlings from appearing nor choke the sal regeneration when the final fellings are made,

(*b*) *Burning to remove the dead leaf layer.*—This is a measure that should begin in P. B. II or 20—15 years before the end of the rotation and should be carried out in all areas where regeneration is absent except in very dry areas or steep slopes. In the Uniform System there will be very few such areas as they will be allocated to a Hill Working Circle. But in such areas burning will be likely to cause more harm than good. The fire will tend to dry the soil and in very dry areas it is the physical dryness that prevents regeneration. Also on steep slopes leaves do not lie in blanket-like masses but tend to collect in hollows and ridges where they may help to collect what moisture there is, while the soil is left exposed in a number of places.

But elsewhere and especially in damp areas where weeds are likely to be troublesome also, ground fires should be lit in all areas in P. B. II. It is possible that these ground fires should be bi-annual or triennial and not annual. If sal seedlings result from the ground fires of one year they may be killed by the ground fires of the next year. But if left undisturbed for a year they should be strong enough to coppice after the next ground fire. (*Note.*—Another possible advantage of ground fires is that they may decrease the number of cockchafers. The damages done by cockchafer grubs to young sal seedlings, although considerable, are not always recognised).

(*c*) *Preparatory fellings.*—The previously described burning operations and preliminary cultural operations favouring mixed crops and undergrowth may and should result in sufficient sal regeneration to cover the ground and weeds should be reduced in number and intensity to an useful undergrowth only. But it is possible that in spite of these conditions the sal regeneration will be unable to become strong enough to shoot straight away on the removal of the canopy. Then, while continuing the burnings (annually now if there is sufficient sal and if weeds are still a danger),

a light preparatory felling should be made in the overwood a few years before final regeneration fellings are due. But the object of these fellings is not to allow the regeneration to grow up. Their object is to strengthen the regeneration so that a subsequent clear felling will be followed by rapid growth of the established sal.

(*d*) *The Final Regeneration Felling.*—Previous management should have resulted in a mixed mature even aged crop perhaps thinned out by a preparatory or, say, an increment felling. Underneath is a light undergrowth among or under which is established sal regeneration. The regeneration may be in the form of thick groups of sal "switches" or by small crooked suppressed saplings. The rootstocks of all these should be as thick as man's thumb or more. Actual regeneration operations should then be :—

(*i*) Clear fell the overwood.

(*ii*) Cut back all the underwood, including the sal regeneration.

(*iii*) Burn the remains of felling debris at the end of March.

Each of these operations are justified below :—

(*i*) *Clear felling.*—Except where protection against frost is required there is no object in retaining any overwood above established regeneration unless a few trees (not more than 6 or 8 per acre) are kept throughout the second rotation to produce especially large timber. By retaining an overwood its subsequent removal will cause damage, while their prolonged presence is unlikely to cause the area to become more fully stocked. If not too large, areas that are understocked, should be left as they are. If they are large they should be artificially regenerated. Artificial regeneration will not be possible until work generally becomes more intense. But until it does

become more intense the presence of certain areas in which sal is scanty or absent is not of great consequence owing to the unwieldiness of most coupes. In any case such areas are sure to fill up with something. Nevertheless these unregenerated areas should be avoided. To avoid them the final regeneration fellings must be reserved only for those areas where established regeneration exists. Consequently it is essential to obtain regeneration in P. B. II, that is, say, 15 years before the end of the rotation.

(*ii*) *Cutting back.*—The main object of this operation is not to obtain uniformity. After 20—30 years the crop would be uniform anyhow. But established regeneration is often crooked and suppressed. Cutting back will stimulate such suppressed shoots and enable them to throw out a vigorous straight shoot or shoots. This stimulation is not confined to suppressed saplings but applies also to switchy advance growth. Small switches may continue to stagnate unless cut back. Moreover cutting back forces the plant to send out a shoot that originates from below the collar which is usually below the seat of any disease that may exist in the suppressed advance growth. Cutting back should be done in the cold weather before spring growing season.

(*iii*) *Burning.*—After cutting back (*i.e.* coppicing) everything should be burnt. The object of this burning is :—

(*a*) The possible stimulation of sal regeneration. (This is doubtful, and in fact, experiments in the Sambalpur Division indicate that burning checks sal growth for the first year).

(*b*) The discouragement of species other than sal especially evergreens. Evergreens are certainly checked by such a burning but a check should not be necessary if burnings have been executed for some time previously. Nevertheless in damp areas this burn-

ing is valuable for this reason that evergreens are certainly checked more than sal. But one burning like this is not in itself enough to enable sal to get away from weeds in damp fertile places.

(*c*) The destruction of felling debris and consequent elimination of future uncontrolled fires. This is a very valuable result. The considerable felling debris left in most coupes owing to incomplete utilisation is a grave danger from future fires in the regeneration area.

(*d*) The destruction of insect and, possibly, fungoid pests. This is possibly the most important of all. At present the large quantities of material in coupes form a perfect breeding ground for forest pests. That the pests take advantage of these conditions is shown by the large number of abandoned logs riddled with the galleries of longicorn beetles. When the beetles have increased sufficiently they turn their attention to living trees. The damage done by longicorns in India is very heavy and epidemics that have occurred in the United Provinces and Central Provinces are well known. It is more than possible that a thorough burning of the regeneration area after felling will prove a great safeguard.

The above outline of the method of working an even aged forest of sal would, I believe, help to ensure regeneration. I do not say that such extended measures as those described for burning during P. B. III or P. B. II will everywhere be necessary. Nor do I say that all soils will be spoiled by an even aged sal crop. For instance some soils, such as many laterite and haematite soils, are so porous and well drained that I think ordinary preparatory and seeding fellings may induce regeneration. Again in many places sal regeneration appears in spite of anything the forester may do. But the above outline is intended to make suggestions for the management of even aged crops where sal

regeneration is scanty, and to indicate a treatment that will retain some of the advantages of an uneven aged crop. Other foresters will undoubtedly think of improvements.

2.—*The Group Selection System.*

To retain the optimum conditions for sal regeneration I have shown previously that an uneven canopy is necessary. Also economically it is clear that clear fellings or a close approximation to clear fellings are the most advantageous. The Uniform system approximates to clear fellings but departs radically from an uneven aged crop. The Selection system gives the desired uneven canopy but fails to give concentrated working. In what follows I have tried to describe the essentials of a system that balances an uneven canopy with concentrated working and which in consequence may solve many difficulties in regeneration without sacrificing economic conversion.

General Scheme.—In the true Selection system annual working extends over the whole forest. Only those trees that have reached the exploitable age are removed, and these mature trees are scattered evenly throughout the forest. The felling cycle, therefore, is one year. In the clear felling system all exploitable trees are concentrated in one coupe. Working, therefore, is concentrated in that coupe. In these conditions the felling cycle is as long as the rotation. By increasing the felling cycle in the one system and by reducing it in the other, the two systems merge into each other when the felling cycle equals half the rotation. Reduction of the felling cycle increases the irregularity of th canopy; lengthening the felling cycle increases its regularity.

Therefore the problem is to fix a felling cycle which will give a sufficiently uneven canopy to ensure regeneration and yet will retain a certain degree of concentrated working. To decide this it is necessary to settle what minimum number of mixed age classes are required to ensure regeneration. At present there is little or no data on which to work. But 3 would seem to be the absolute minimum while 4 would be preferable and probably

ample. To obtain four age classes intimately mixed together everywhere, a felling cycle equal to ¼th of the rotation is necessary.

We will suppose, therefore, that four mixed age classes are necessary. The scheme would then be somehow as follows :—

First, the forest should be divided into a number of felling series, conveniently one to each Range. The sub-division reduces the size of a coupe in one place and distributes the work so that work can be more intense in each coupe. If the rotation is 120 years (as in the Saranda Division now) then the felling cycle will be 30 years and there will be 30 coupes in each felling series. After one rotation the theoretical arrangement of age classes in these coupes would be :—

Coupe 1 (first felled) :—0, 30, 60 and 90 years.

Coupe 2 :—29, 59, 89 and 119.

Coupe 3 :—28, 58, 88 and 118, etc., etc.

This is all straightforward and exactly similar to the ordinary selection system. As regards utilisation, it can be seen that the system has one quarter the intensity of the clear felling system. But the success of the system depends entirely on the manner in which fellings are executed. Below I have outlined some guiding principle.

1. Fellings of mature trees (*i.e.*, those that have reached the size equivalent to maturity) should, when possible, be made in such a way that groups of a large size are avoided. For example, a group should never have a diameter greater than ½ chain. This is not a true group system, for the group system approximates to an even aged system. But where quantities of regeneration exist under a mature even aged crop, it cannot be helped. Then the overwood had better be clear felled. But where there is no regeneration under a mature even aged crop or where established regeneration does not extend over large areas, trees should be removed in twos or threes. The whole success of the system depends on unevenness and the smallness of groups, so that the marking officer will have to be allowed his discretion in leaving certain mature trees and even felling immature trees (see 2 below) for the sake of irregularity. Leaving mature trees until the coupe is worked again has the advantage that selected trees may be

allowed to grow beyond the rotation and so provide particularly large specimens.

(2) At the same time, as the main felling of mature trees, a thinning should be carried out. (*Note.*—This is an advantage in concentration over the clear-felling system!). This thinning will constitute one of the most difficult technical operations in the system. It must be a genuine thinning and not an attempt to catch increased revenues and yields. While thinning the marking officer will have to remember the following principles:—

(*a*) The crop should be left uneven.

(*b*) The crop should be mixed (*i.e.*, species such as *asan*, *bija*, *jamun*, etc., etc., should be regarded as the equal of sal).

(*c*) The age classes should all be properly represented. This is very difficult, as it is hard to settle how many saplings are necessary to produce one mature tree. If a comparison with a Yield Table (*i.e.*, figures giving growth data of a normal even aged crop) is allowed, then in quality II, there are 780 trees 20 years old per acre, 145 trees 60 years old and 82 trees 90 years old, *i.e.*, proportions of (very approximately) 10 : 2 : 1. This, of course, is not truly applicable to an uneven forest, but it serves to give an idea. The marking officer will have to keep this picture in his memory and aim at the proportions when removing trees for their crookedness, ill health or congestion.

(*d*) Too much importance should not be laid on coppicing crooked saplings. A sal sapling has great powers of straightening itself and a great aptitude for pushing through and between older trees. Part of the value of the system is that saplings become established under a canopy and are then capable of putting on *wood* increment as soon as a gap is made above them.—(*Note.*—In practice, thinning among saplings would be better left until the year after the fellings. A cleaning would then be

necessary anyhow to clear up damage from the main fellings).

From the above principles it can be seen that irregularity is the basis of the system, both in thinnings and the main fellings. It can also be seen that the combination of thinnings with the main fellings introduces a grave danger of over-cutting. But the danger is hardly more than that obtaining at present where improvement fellings are prescribed for semi-mature periodic blocks in the Uniform system. To make all safe it is necessary to have some volume check on the outturn. But this is a great difficulty. Even when the uneven aged forest is 'normal', ordinary Yield Tables are not applicable, since they are made for even aged crops. To make yield tables for an irregular crop is difficult, if not impossible, as it is so difficult to define what a 'normal' uneven aged crop is. Without a defined normality it is impossible to fix a standard on which to base yield tables. On the other hand, where a forest has been worked under a more or less definite type of uneven aged system with a stated object for a considerable length of time, it should be possible to obtain figures of 'normal' yield for that particular system in that particular forest. Each year the volume of material removed in thinnings and final fellings would be measured. With regular working these figures should reach a maximum and remain there. Once this maximum is reached the forest is normal. This is an ideal picture, and is meant to show the difficulties of the position as well as the possibilities. To begin with the yield would have to be by volume; but the volume should be checked. To check the volume I can see nothing better than using intelligently yield tables for even aged crops. They would have to be used intelligently and the figures checked carefully every few years by the results, while all marking would have to be done by a reliable and skilled officer. Results could be checked by seeing the normality of the forest a few years after fellings and seeing whether the final volume yield indicated by the Yield Table coincided with the area yield.

Besides actual marking and felling, cultural operations are likely to be necessary. For instance ground fires may be nece -

sary to remove excessive leaves or check weed growth. These ground fires may have to be supplemented by soil wounding where regeneration persistently fails. At first sight it might be thought that ground fires are impossible owing to the mixture of all age classes. This is certainly a difficulty. But fires will, as a rule, be necessary only where regeneration is absent. Where regeneration is vigorous no fires are necessary. Where it is weak and smothered by weeds fires will certainly check it, but the fire will not kill the sal and it will check obnoxious weeds still more than it checks the sal.

From the above outline it can be seen that the Group Selection system possesses many disadvantages. It is obviously a difficult system to plan, organize and execute. Consequently, a highly skilled staff is necessary, and a staff that is skilled not only in the upper grades but in many of the lower grades as well. Also it is a system to which the forester should become accustomed. Hence its success in certain parts of the Black Forest where a Divisional Forest Officer remains for many years in a single charge. Again, the final fellings are admittedly not so concentrated as in a Uniform system, and also, fellings will cause a considerable amount of damage to the understorey.

The advantages are nearly all silvicultural. The whole object of the system is to produce the optimum silvicultural conditions so that the sal remains healthy and regenerates easily. If these conditions can be obtained successfully under a Uniform system, then a Uniform system is decidedly preferable. But another advantage of the Group Selection system where forests have not yet been evened, is that there is little sacrifice during its introduction. In the conversion of the Bihar and Orissa sal forests to an even aged type of forest there is great wastage. The crops contain a mixture of age classes. All these are felled, but only those over 1′ in diameter are exploited. In the Group Selection system no tree under, say, 1′–6″ or even 1′–9″ diameter would be felled. This would please timber traders who prefer trees over 1′–6″ diameter; any demand for poles and small timber could be met by thinnings.

Another advantage is that the system is suitable to a large number of crop variations, as it is a more adaptable system. In the Conversion or Uniform system areas have to be excluded which could be included if worked under the Group Selection. In fact by making certain exceptions in the felling rules the Group Selection system could be made to include the hill type sal, so that all the sal tracts could be included in one working circle.

E. Conclusion. From the outlines of the two systems explained it is clear that the Group Selection is not so attractive as the Uniform Type System. It has less concentrated fellings making exploitations more difficult, while silviculturally it is more intense requiring a higher degree of skill in management. But it gives a type of forest that is likely to be more favourable to the regeneration and health of the sal. A system has no value if it cannot maintain the health of the forest, and a system that provides the easy natural regeneration of a crop is preferable to one that makes it difficult or requires artificial regeneration.

In this essay I have tried to summarise the general conditions affecting sal regeneration and I have laid emphasis on those factors that I think important. I have shown that there are grave doubts whether an even aged system is silviculturally desirable. But I have also tried to suggest means to make an even aged system possible. In the event of complete failure an uneven aged system will be essential, and in the 'Group Selection' system I have outlined a system that maintains a certain degree of concentrated working and yet retains an uneven aged cover. Even if the arguments are wrong or the deductions from observations mistaken, I hope that what I have written will enable readers to see the problem of sal regeneration in a light that may help to clarify the undoubted darkness that still enshrouds the working of sal forests.

NOTES ON SLEEPER SECTIONS AND SLEEPER TREATMENT ON BRITISH RAILWAYS.

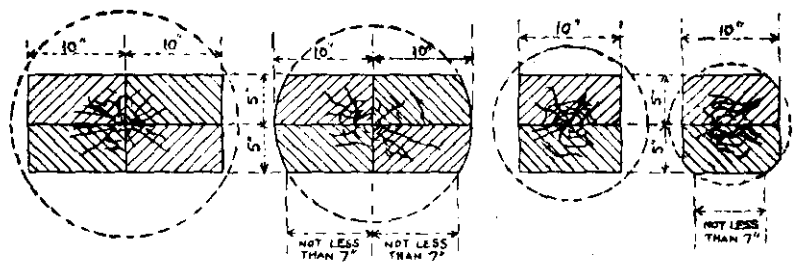
Technical Paper No. 269 gives some Notes on half round sleepers and contains an article by Mr. L. N. Seaman, M.A.

B.Sc., A.M.E.I.C., on the relative strength of heartwood and sapwood. This article clearly shows that properly seasoned sapwood is quite as strong as, and in some cases (*e.g.* chir) actually a little stronger than, heartwood. Consequently it should only be necessary to give the sapwood some efficient form of preservative treatment to make it in every way as serviceable as heartwood. It is however recognised that all users of timber in India, who are accustomed to see untreated, unseasoned sapwood, when used for out door purposes, decay with great rapidity and entirely disappear in a very few years, are not likely to be easily convinced. The only actual case that can be produced in evidence in India is that of the treated chir sleepers supplied during the years 1915 to 1917 by the United Provinces Government to the North Western Railway and Oudh & Rohilkhand Railway. These sleepers were treated in open tanks with a 50/50 mixture of creosote and earth oil. This treatment gave good penetration into the sapwood but only slight penetration into the heartwood. It is interesting to find that it is the sapwood part of these sleepers that has lasted best. An account of these sleepers may be found on pages 25 to 32 of Technical Paper No. 253. And in an article on Treated Sleepers on page 18 *et seq* of the Quarterly Technical Bulletin for October 1927.* Confirmation from sources outside India is however available *vide* extracts from the Cross Tie Bulletin which forms part V of Technical Paper No. 269. It is also very interesting to find that confirmation from Great Britain is also available as the following extracts from Modern British Permanent Way by C. J. Allen clearly show :—

> "As regards the ordinary sleepers, most contracts insists that at least 50 to 75 per cent. of the sleepers shall be supplied full to the sectional dimensions of 10 in. by 5 in.; the remainder are then usually allowed to be supplied with the width on one side only a trifle under the 10 in., down to a minimum of about 7 in. Fig. 68 will make this clear. The narrow side is then laid in the ballast, the chair being attached to the upper side, which holds the full

* See Note at the end of this article.

width of 10 in., but such sleepers are only employed in subsidiary lines or sidings. Fig. 68 also shows the customary method of cutting up a tree for sleeper purposes in such a way that each sleeper includes a certain proportion of heart wood."



I II III IV

Fig. 68.

Fig. 68 — Method of Cutting Sleepers.

From this it is clear that the half round or slab sleepers, in the fourth figure as well as the "wany" sleepers in the second figure must contain a large amount of sapwood. It is also interesting to see that from 25 to 50% of the sleepers accepted are of these kinds. The following extracts make the matter still more clear:—

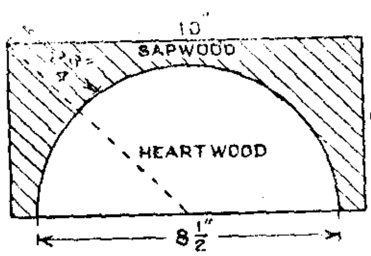
"It may be well, as usual, to quote from a characteristic British specification in relation to sleepers:—

"The rectangular sleepers are to measure 9 ft. long, 10 in. wide and 5 in. thick. The timber to be of good sound Baltic red wood, free from shakes or other defects. Whitewood sleepers will not be accepted. 90 per cent. of the sleepers to have not less than 8½ in. diameter of heart wood at both ends, and the remaining 10 per cent. to have not less than 7 in. diameter of heart wood at both ends. As regards one side in width of the sleepers, 50 per cent. of the sleepers are to have on that side a flat surface not less than 9 in. wide throughout the entire length; 40 per cent. of the sleepers are to have on that side a flat surface of not less than 8 in. wide

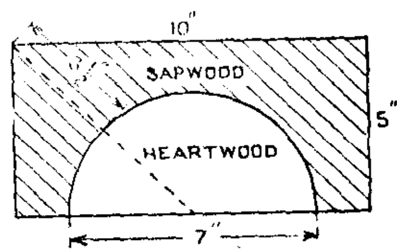
throughout the entire length, and the remaining 10 per cent. of the sleepers are to have on that side a flat surface not less than 7 in. wide throughout the entire length. The sleepers delivered under this contract must be of last autumn's defloatation at the port of shipment, and sleepers delivered of a defloatation earlier than the above named will not be received under this contract."....

"Another specification requires the sleepers to be 'root or middle cuts of well-wooded timber, giving two sleepers out of the block. All the sleepers to be of the best sound wood, free from shakes, splits, and loose knots, and reasonably free from sapwood'. The provision as to heart wood in the former specification, and as to at least two sleepers being cut from the block in the latter, ensures that only trees of a sufficient age shall be employed for the purpose."

At first sight this may seem to point to the fact that the sapwood is considered undesirable. But it is necessary to consider more carefully the effect of these specifications. 90 % of the rectangular sleepers must have not less than 8½" diameter of heart wood at both ends and 10 per cent. not less than 7 in. The drawings given below show what this really means, that is, that 90 per cent. of the sleepers may have up to 43 per cent. sapwood and 10 per cent. up to 61.5 per cent. sapwood. The provision that at least two sleepers should be cut from a log is found in most Indian specifications and is sufficient to ensure that very young trees are not sawn into sleepers.



57% HEARTWOOD.
43% SAPWOOD.



38·5 % HEARTWOOD.
61·5 % SAPWOOD.

It is also abundantly clear that the wany and half round or slab sleepers in figures 2 and 4 of Fig. 68 must have much higher percentages of sapwood than those given above for rectangular sleepers, because in the case of the latter much of the sapwood *is cut away, whereas it is not in the case of the other* sleepers. The present specifications for deodar and chir sleepers on the North Western Railway lay down that one broad face of the sleeper must be entirely free from sapwood, a more exacting specification than the above quoted British one. It must be remembered that "The wood used almost exclusively in this country (*i.e.*, for sleepers in Great Britain) is known variously as Baltic pine, Baltic redwood, or Baltic, Dantzig, Riga or Swedish fir. *This is really the true Scotch pine and is a soft wood re*quiring preservative treatment, usually with creosote." The timber of the Scotch pine is very similar in most respects to that of the common chir pine of the Himalayas.

It is therefore quite clear that although in Britain there are some restrictions regarding sapwood they are not severe, and that sleepers with large percentages of sapwood are in common use, this also, it may be remembered, with a soft wood timber such as Scotch pine, *which may have up to four inches of* sapwood.

In the case of sal, where there is on the average a sapwood zone only one inch deep, an untrimmed half round sleeper cut from a 12 in. diameter log could have only 30 per cent. of sapwood at the most. Sleepers from larger logs slabbed at the top and trimmed at the sides would have even a smaller percentage of sapwood.

That the value of preservation treatment is fully recognized in Britain is clearly shown from the following extracts from Modern British Permanent Way:—

> "Preservative treatment undoubtedly does increase the life of timber in a considerable degree. Statistics were given in the Bulletin of the International Railway Congress of 1904 to show that pickling on the average adds 100 per cent. to the life of oak sleepers, 200 per cent. to that of pine, and no less than 400 per cent. to that of beech.

> The creosoted pine sleepers employed in this country may last from twelve to eighteen years or even twenty-five years if laid in branch lines, but only from eight to ten years when not treated. Oak and beech when creosoted have been found in France to last from fifteen to twenty-five years, and when treated with cupric sulphate for fifteen years, as against only three to five years, untreated."..........." These figures throw an interesting light on the behaviour of different woods in different localities, and also demonstrate without question the sound economic value attaching to preservative treatment."

It is particularly interesting to note that even an excellent timber like English oak is treated.

I feel sure that if Indian Railways would take half round sleepers (trimmed at the top and sides if necessary) and wany sleepers of the type shown in fig. 68, they would get them considerably cheaper than the standard rectangular sleeper, and that the difference in price, certainly in the case of sal and probably in the case of deodar, would more than pay for the cost of preservative treatment. In this way a better, cheaper sleeper, with a longer life and a lower annual cost could be obtained. The preservative treatment of sleepers in India is still in its infancy but there is undoubtedly a great future for it. In conclusion I would like to quote a remark by Mr. F. W. Allum in the Report of the Sleeper Enquiry Committee 1923-24 :—

"Chief Engineers of Railways all over India are inventing new forms of the cast iron sleeper, so I may be excused for strongly advocating the treated sleeper; in this connection I would repeat what a great French mathematician said to the readers of his works 'Go ahead and faith will come to you'".

W. A. BAILEY, I. F. S.,
Timber Advisory Officer,
Railway Board, Simla.

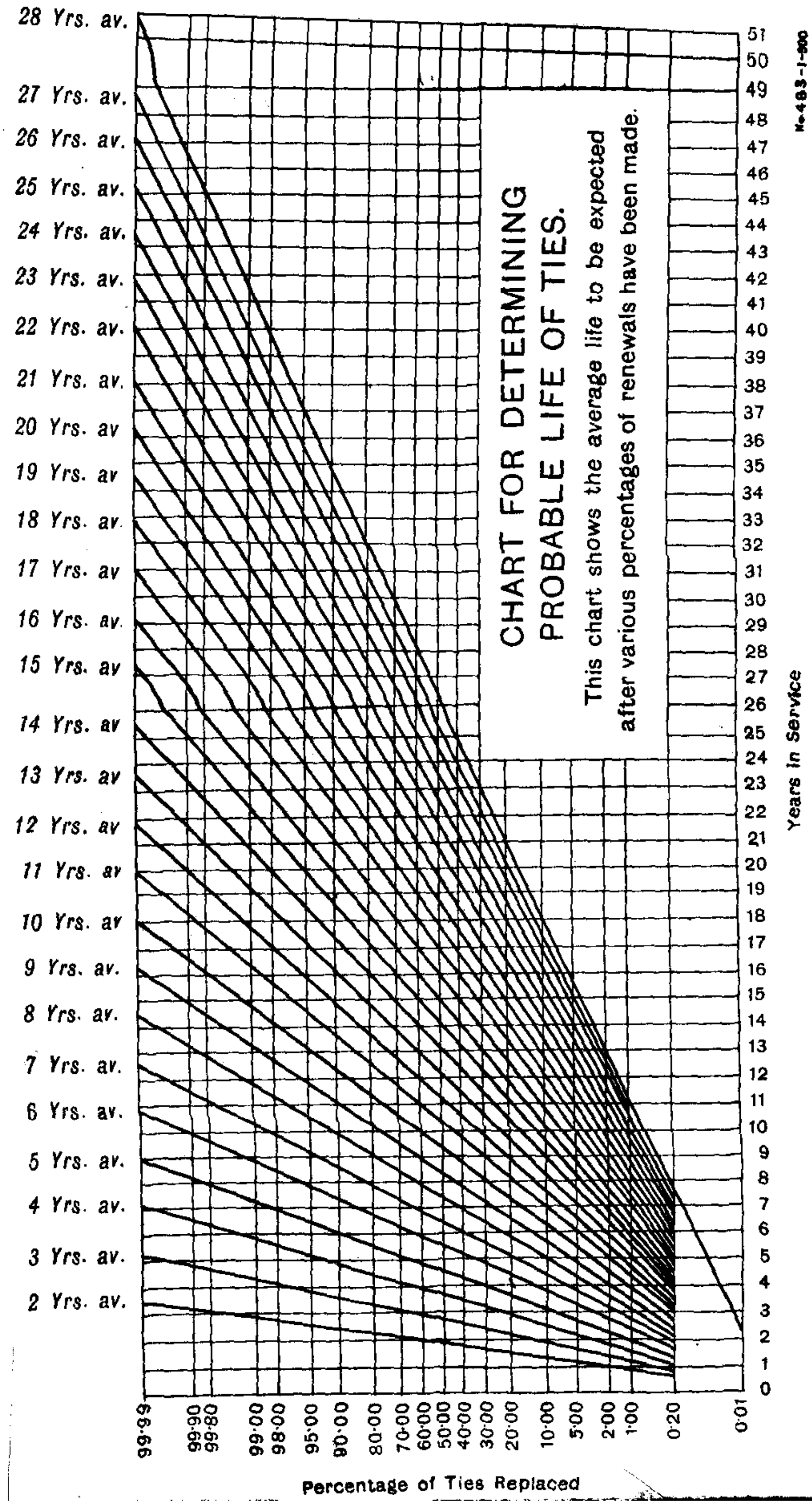


CHART FOR DETERMINING PROBABLE LIFE OF TIES.
This chart shows the average life to be expected after various percentages of renewals have been made.
28 Yrs. av.
27 Yrs. av.
26 Yrs. av.
25 Yrs. av.
24 Yrs. av.
23 Yrs. av.
22 Yrs. av.
21 Yrs. av.
20 Yrs. av
19 Yrs. av
18 Yrs. av
17 Yrs. av
16 Yrs. av.
15 Yrs. av
14 Yrs. av
13 Yrs. av
12 Yrs. av
11 Yrs. av
10 Yrs. av
9 Yrs. av.
8 Yrs. av.
7 Yrs. av.
6 Yrs. av.
5 Yrs. av.
4 Yrs. av.
3 Yrs. av.
2 Yrs. av.
Years in Service
51 50 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Percentage of Ties Replaced
99·99 99·90 99·80 99·00 98·00 95·00 90·00 80·00 70·00 60·00 50·00 40·00 30·00 20·00 10·00 5·00 2·00 1·00 0·20 0·01
No 483-1-500

NOTE ON THE OPEN-TANK TREATED CHIR SLEEPERS ON THE NORTH WESTERN RAILWAY.

The results of the inspection made in 1927 show the following:—

1. Out of 7,411 sleepers laid in 1915 in the Lahore Division *none* had been replaced up to 1927.

2. Out of 34,988 sleepers laid in 1916 in the Lahore, Ferozepore, Multan and Delhi Divisions, 7 per cent. had been replaced up to 1927.

3. Out of 3,410 sleepers laid in 1917 in the Delhi and Quetta Divisions, 0·7 per cent. had been replaced up to 1927.

4. Out of 1,04,359 sleepers laid in 1918 in the Delhi, Rawalpindi and Quetta Divisions, 6 per cent. had been replaced up to 1927.

As referred to in Cole's "Permanent-Way Material", Ninth Edition, 1928, para. 76:—

> "The United States Department of Agriculture (Forest Products Laboratory) states that there is no difference in the *relative* times and quantities of sleepers renewed, whether the sleepers have been treated or left untreated, but the average life of the latter is longer. No ties require renewal up to 30 per cent. of *average life*, 60 per cent. at the average life, and the whole will have been renewed at 1-2/3 "the average life." (See also pages 7 to 11 of the Quarterly Technical Bulletin for April 1927).

From the "Chart for determining the probable life of ties," which is herewith reproduced, it may be seen that when rejections amount to 7 per cent. in 11 years, an average life of 18 to 19 years may be expected. When rejections amount to 6 per cent. in 9 years there is an expected average life of between 16 and 17 years. From items 1 and 3 no definite conclusions can be drawn as to the expected annual life, but it is clearly shown that these open tank treated chir sleepers have done extremely well. It is difficult to conceive a more con-

vincing proof of the value of preservative treatment, and the strength and durability of treated sapwood, than that furnished by these sleepers, when it is remembered that the average life of an untreated chir sleeper is only about 3 or 4 years. The writer of this note passed and treated many of these sleepers himself in 1915/16 and can state with authority that there was a very high sapwood content in large numbers of them, in fact no sleepers were rejected simply on the grounds of excessive sapwood.

W. A. BAILEY, I. F. S.,
Timber Advisory Officer,
Railway Board Simla.

DAMAGE TO ACACIA ARABICA BY FOMES PAPPIANUS BRES.

Fomes pappianus was found attacking an *Acacia* in Somaliland as early as 1896 but its presence in India was discovered for the first time in 1902, when a specimen was forwarded by the Conservator of Berar to the Cryptogamic Botanist to the Government of India. Unfortunately the life-history of this fungus has not been properly worked out, and very little is known about its mode of infection besides the knowledge gained empirically during the last quarter of a century and the behaviour of other *Fomes*.

The damage caused by this fungus to *Acacia arabica* (*babul*) consists of heart-rot. The mycelium infested wood becomes excessively brittle, so that branches and even the trunk snap off in the middle. In the early stages of the attack the rotted heartwood is reddish to purple in colour. Black dots become prominent later on. Besides these black dots white patches are found, and these white patches eventually give rise to holes. In some cases the roots die and rot away beginning from their extremities, and the tree having no longer any hold in the soil gets blown down easily. The portion rotted is quite irregular.

It has been observed that of the three varities of *Acacia arabica, telia* variety is really the most susceptible to attacks by

Photo. by E. L. P. Foster.

Fructification of Fomes pappianus on Acacia arabica.

Photo. by E. L. P. Foster.

Cross-section of a small Acacia arabica
showing the heart-rot caused by Fomes pappianus.

this fungus, but the other two varieties *viz.* the *kauria* and the *Ramkanthi* suffer more from its attacks than *telia*, because the wood in their case is not so compact and the *kauria* with its massive crown gives way more easily to the action of the wind.

As has been remarked above very little is known about the mode of infection of this fungus. The fact that ploughing the soil of an infected area reduces the infection indicates the propagation by means of hyphae. While the destruction of the sporophores also reduces the infection considerably which indicates infection by spores. It is noteworthy that young and healthy *babul* is not attacked by this fungus. Most of the *babul* areas infested by this fungus are those which were in their early age attacked by *Coelosterna scabrata* and which have survived the ravages of that pest—at a great loss of vitality no doubt.

The following remedial measures have been adopted in Berar with a fair amount of success, and are suggested tentatively until we know more about this fungus:—

(1) Thinnings must be properly carried out, so as to improve the vigour of the trees. It is observed that the ravages of this fungus are worst in crowded crops.

(2) Pruning must be avoided.

(3) Sporophores must be destroyed. This measure did go a long way in reducing the severity of the pest in Loni felling series of Akola Division (Berar).

(4) In badly infected areas soil may be cultivated for 3 years before sowing *babul*. In Berar *babul* is raised artificially along with field crops and the lessee grows only his crop for the first two years. This measure does free the soil of hyphae to a considerable extent, but in badly infected areas three years' cultivation is often necessary,

(5) *Babul* must be grown mixed. This is not easy as *babul* is generally grown in places where owing to soil and scanty rainfall few other species will grow. Experiments are being made in Berar to find suitable companions to *babul*.

This sums up all the information that has been acquired in Berar about this fungus. It is hoped that it may prove helpful to forest officers growing this species in other parts of India and stimulate their interest in further study of this fungus which is doing considerable damage in the valuable *babul* plantations.

S. A. VAHID, I.F.S.,
Silviculturist, C. P.

NOTE BY THE FOREST MYCOLOGIST.

The paper relates the results of experiments on control of the disease which were suggested in 1903 by Dr. E. J. Butler, the then Cryptogamic Botanist to the Government of India and by Mr. E. E. Fernandez, Conservator of Forests, Berar (*Indian Forester*, Vol. XXIX, 1903, pp. 246 to 249.) The conclusions on varietal resistance are apparently all based on field study only and the principal point, *viz.* the nature of infection still remains unsolved.

K. BAGCHEE,
Mycologist.

13th September 1928.

PRIZE DAY AT THE FOREST COLLEGE, DEHRA DUN.

Speech by the Inspector General of Forests on 27th October 1928.

"This is the first prize day to be held in India for the distribution of diplomas for the students who have gone through the Indian Forest Service course at the new College.

"Trained forest officers have been engaged for the Indian Forest Service since 1866, the training having heen carried out up till the year 1886 in France and Germany. In 1887 Sir William Schlich started the training of forest officers at Coopers Hill and the training continued there until 1906. Since then the majority of the students have come from Oxford, where Sir William Schlich was the first Professor of Forestry, and some have come from Edinburgh and Cambridge. In 1926 the first

course at Dehra Dun began under the professorship of Mr. Trevor. During this long period forestry in India has made great strides, our area having risen to 160 million acres and the revenue having risen from 17 lakhs in 1874 to 264 lakhs in the year 1926-27. It is true that the net yield per acre of forest is only $2\frac{1}{2}$ annas but it must be remembered that many large and remote areas yield nothing at all at present and that valuable forest near to centres of cultivations and large towns yield handsome profits. There is no doubt that it will pay the country to keep under strict control all the forest areas we can, as they are bound to become more and more valuable, not only to supply valuable timber for India and other countries but also to provide the wants of the villagers in the way of fuel, wood and grazing, and to protect hillsides and barren areas. The probationers who are now leaving the College must remember that they have great traditions of a fine service to follow and that their duty is to do their utmost to improve and develop the property left to us by the pioneers, who were laid by the great Sir Dietrich Brandis. I want them to remember that the great thing is to be practical. Live in your forests as much as you can and get to know them and the people who live in and near them. Remember that in forestry an ounce of practical work is worth a ton of theory and try to avoid the great pitfall of excessive writing. When you start as a Ranger or a D. F. O. do not imagine that you can run your range or division by writing orders, however well expressed and admirable they may be. The great thing is to go out and do the work yourself—take off your coat and show the forest guards how to do it. If you do this, I am sure you, wil find that the forest life is the finest life in India, as I have always found it.

"I must say how extremely sorry I am that Mr. Trevor is not with us to-day. He takes the greatest interest in the College and in the students, and to him and to the teaching staff of the College and to the staff of the Forest Research Institute I offer my best thanks for all they have done in starting the new College. I wish all those who are leaving the best of fortune in their new careers, and we shall always be ready to do all we can to help our students to obtain employment in suitable services. I wish

I could have announced that all the students had passed, but I am afraid that is impossible this year."

Diplomas were awarded as follows :—

1. S. Ramaswami	...	Private student.
2. J. Banerji ...	...	Government student.
3. A Muthanna ..	...	Private student.
4. G Kasilingam	...	do.
5. M. N. Bahuguna	...	Tehri State.
6. M. M. Saklani	...	do.

Prizes were given to the following students :—

Hill Memorial Prize for Silviculture (Schlich's Manuals).	C. S. Purkyastha.
McCrie Memorial Prize for Management (Troup's Silvicultural System).	J. Banerji.
Hon'ble Member's Prize for best practical forester (Watch).	J. Banerji.
Prize for Surveying and Drawing (Prismatic Compass).	S. Ramaswami.
Prize for Zoology (Binoculars) ...	A. Muthanna.
"Indian Forester" Prize for Botany (Despatch Box).	S. Ramaswami.

SIAM.

A Lecture given by MR. D. BOURKE-BORROWES, Late Forest Advisor to the Siamese Government, before the Central Asian Society. April 1928.

Siam.—One of the few autocratic monarchies left extent lies in one of the least frequented quarters of the globe. She has not, however, for all her remoteness, escaped the repercussion of current ideas, and she has begun in many ways to conform with the general modernisation of her Asiatic neighbours.

Mr. Bourke-Borrowes, to quote the Siamese Minister, has the gift of exposition, and his able lecture, illustrated by his shrewd comments, presents a vivid picture of the country, its resources and the trend of its development.

The Siamese, like the Japanese some time ago and the Chinese more recently, have arrived at a stage of national self-consciousness where the presence of large foreign controlling interests in the exploitation of the country is apt to be resented, and a desire engendered for complete economic independence. This sentiment, in itself creditable enough, is liable to be pushed to extremes and to blind its possessors to their true interests. In a country like Siam which possesses as yet only two classes, the ruling or official caste and the cultivators, but no mercantile or industrial middle class, the exploitation of the country is bound to depend for some time to come on foreign capital.

Like many other backward countries at the present day, Siam seems to be a prey to the illusion of modernity, a tendency to ignore the essentials of orderly development and concentrate upon the more showy and superficial elements. Thus Mr. Bourke-Borrowes relates his astonishment at finding aeroplanes engaged in carrying mails to distant villages of Eastern Siam, when that extensive region was not yet equipped with a single metalled road!

In fact, with the exception of a very few agricultural developments, the most notable of which—the Prasak barrage—is due to British irrigation engineers from India, Mr. Bourke-Borrowes finds

the country in a very backward state. Only one-fifth of the total area has been surveyed, and there is a complete absence of technical information concerning the two most important industries of forestry and mining. The teak forests are being systematically over—exploited, and vast areas annually destroyed by shifting cultivation.

For many years very cordial relations have existed between Great Britain and Siam and the former enjoys to this day the role of most favoured nation. Approximately 86 per cent. of the total imports of Siam go to British territory and 67 per cent. of the total Siamese imports are of British origin. The teak forests, which form one of the most important sources of the country's revenue, and rank as the second largest source of the world's supply of this material, are very largely under control of British firms. The method of exploitation is similar to that employed in Burma; the timber is dragged by elephants to the innumerable waterways and floated down to Bangkok.

The export of lac, for gramophone records, has increased of late to such an extent as to bring this important minor product on a level with teak. In this respect its position may soon be analogous to that of this country, where the export value of shellac is already considerably greater than the total value of the timber exported.

H. P. D.

FOREST AND STREAM-FLOW EXPERIMENT AT WAGON WHEEL GAP, COLORADO. FINAL REPORT, ON COMPLETION OF THE SECOND PHASE OF THE *EXPERIMENT*.

By C. G. Bates, Silviculturist, Forest Service, and A. J. Henry, Meteorologist, Weather Bureau. (Monthly Weather Review No. 946, Supplement No. 30, 1928, Washington).

There are few experiments on forestry matters which have attracted international interest to an extent comparable with the United States Forest Service investagations at Wagon Wheel Gap in Colorado. Hitherto, the classic work on the subject has been Engler's, which was carried out in the Sperbel and Rappen streams

some 25 miles east of Bern in Switzerland, and is described in a 600 page report in the publication of the Swiss Forest Research Institute (1919). For 15 years, Engler recorded meteorological and hydrological observations for two catchments, each rather under 200 acres, the one well wooded and the other about one-third forested. The investigation appears very detailed at first, but was really not detailed enough, particularly as regards quantitative data. The chief defect was, however, the lack of proof that the valley poorly stocked would have given the same results before denudation as the well stocked valley now does.

If was partly to provide a satisfactory example in their own country, and partly to obtain results not open to the criticism just mentioned, that the Wagon Wheel Gap experiment was started in the Central Rockies in 1909. Two valleys of about 200 acres each, as similar as possible in all respects and as typical of the country as could be found, were brought under a very intensive study, most detailed meteorological observations being recorded throughout the year, and total run-off and suspended matter carefully measured. After 8 years it was considered that all the data required to establish the comparability of the two valleys had been collected and one valley was completely denuded, observations being carried on for another seven years in both.

It is unnecessary to go into the methods adopted, interesting as they are, and we turn at once to the general results. Frankly, they are disappointing at least from the point of view of the forester in India: in fact conditions are so different that at best they could only apply to a minute fraction of our area. The valleys were at 10,000′ altitude, had an annual precipitation of 21", and falls of one inch or more in 24 hours were only experienced once in 2 years; half the precipitation was snow which covered the ground from October to May; the gradients were moderate and the underlying rock crystalline. The authors in their final sentence warn one of "the need for careful inductive reasoning in the attempt to relate even qualitatively the results... ....to another set of conditions".

The denudated area B had initially on an average 1·7% more run-off than the forested area A. Denudation brought this excess

up to 17%. The difference reached a maximum 3 years after denudation and then fell off rather rapidly and steadily to the end of the experiment; 'though the snow water was made available earlier and in more concentrated volume, the watershed was still capable of absorbing it and of retaining for discharge throughout the year a greater volume than before.' In other words under the particular conditions of the test, denudation has not resulted in deterioration of the value of the area for water storage. Again although the erosion rate for B was 2·8 lbs. per acre per year before and 16·7 lbs. after denudation, no visible erosion was noted and the amount is almost insignificant.

It is a pity all this labour was not expended on an area where the matters under investigation—erosion and run-off—were to be anticipated as active to a greater degree. As it is, the results undoubtedly have a real local value and have usefully supplemented Engler's as to methods of investigation and of surmounting those difficulties of interpretation which comparative meteorological and hydrological observations always present. It may also be feared that they will provide dangerous material in the hands of the unscrupulous anti-forester who will now be able to quote one of the finest forest investigations yet recorded, in support of his assertion that denudation of the forest cover does no harm and may even be beneficial.

H. G. C.

EXTRACTS.

EMPIRE FORESTRY CONFERENCE AT PERTH, WESTERN AUSTRALIA.

The Empire Forestry Conference opened its Australian meetings at Perth to-day. Lord Clinton (the chairman of the Forestry Commission in Great Britain) was appointed chairman and Mr. Robinson, Great Britain, and Mr. Lane Poole, the Commonwealth Inspector-General of Forests, vice-chairmen.

Lord Clinton, acknowledging the welcome extended to the Commission by the State and Federal Governments, said it was

apparent that the control of forestry was well placed in the hands of the delegates of the Australian Governments. The delegates faced their task in the belief that something essential should be done for the advancement of Imperial forestry. He paid a tribute to Lord Lovat, through whose initiative and personal influence and driving force the conference had become an established fact. The conference authorized Lord Clinton to telegraph its greetings to Lord Lovat.

The reports submitted to the conference covered the activities of Great Britain, the Australian Commonwealth, and other Dominions in the improvement of forestry. It was decided to appoint a committee on Australian forestry, the *personnel* to include a certain number of oversea delegates.

The conference sent its greetings to the King, and the Prince of Wales telegraphed his good wishes to Lord Clinton, who replied, expressing his appreciation of the Prince's interest. (*The Times.*)

[The following are attending the conference from India :—

Messrs Richmond, Trevor, Jacob, Blanford, Robertson Shebbeare, Howard and Wilson. Sir Peter Clutterbuck is also attending as a representative of the Government of India. Ed.]

LOCAL TIMBER DEMANDS AND THEIR SUPPLY IN FUTURE.

Cassandra was unpopular as are all prophets who do not prophecy smooth things and no doubt the Trojans, if they had any leisure to think after the sack, said "Serve the woman right" when they learnt of her murder. She does not seem to have had any children but there are folk to-day who swear that professional foresters are recruited solely from among her spiritual descendents.

The Cassandra motif of the following article is bound to annoy many people yet the subject is one which ought to interest the Burman very closely. It touches him literally "where he lives" for it affects his housing and his cooking in the future.

True, he will never have to suffer like the peasant of North China who has to rake together every stick of bramble and every bit of dry grass that he can find to keep himself warm in winter, but most Burmans will object to find themselves paying three or four times as much as at present for house-posts and firewood. Already there are grumbles at increasing shortages of these commodities but the trouble is nowhere acute yet. The grumbles come from those who having eaten their cake are annoyed at not still having it to eat.

Take a look at this table and see what it has to say :—

HARDWOODS.

YEAR.	TOTAL RECORD OUTTURN.		OUTTURN FROM UN-CLASSED FORESTS.		UN-CLASSED OUTTURN PER CENT OF TOTAL.	
	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.
	Tons.	Tons.	Tons,	Tons.	Per cent	Per cent.
1922 ...	718,300	1,065,600	505,000	919,060	70	85
1923 ...	520,240	959,320	346,800	889,980	66	86
1924 ...	403,500	1,004,100	213,320	850,060	52	84
1925 ...	428,900	1,203,500	247,920	962,380	58	80
1926 ...	501,800	1,125,000	320,080	882,640	64	80
1927 ...	526,260	1,097,160	317,360	832,680	60	76

The most obvious fact that strikes one is that Burma is using well over a million tons of timber and firewood every year in addition to teak products and this without counting the material that is used by the ordinary villager free of charge under the existing laws and how much he destroys, of which there is no record.

The next is that over 50 per cent. of the timber and 80 per cent. of the firewood come from the unclassed forests and the greater part of this will never be replaced.

For the moment all that we have to think about the first point is that the quantity is very large indeed and it is not likely

to get any smaller in future. As the population increases the demand for firewood will certainly increase since Burma has no coal to take its place even if the people were ready to use it, while for timber it is a well recognized fact all over the world that every increase in industry means an increased demand for timber even though the industry may lead to the use of substitutes for timber in many directions.

UNCLASSED FORESTS.

The second point is the real crux and to realise its importance one needs to understand what is bound up in the words "unclassed forests." Broadly speaking they mean forests doomed to disappearance, certain to go on deteriorating till they reach the last stage of degradation which can be seen in the waste land (now military area) near Mingaladon.

They came to be doomed on this wise. In the early days of forest reservation, that is the 70's and 80's of the last century and even later, Government decided that the villager must be touched as little as possible by an oppressive, land grabbing Forest Department and told the forester to keep his beastly reserves as far away as possible from the villages so as to leave plenty of forest for the villager to get all his requirements. Large tracs of forest were left outside the reserves and it seemed then that there was enough forest produce for everybody for ever.

The "Plains Reserves" of Tharrawaddy tell the story clearly to any one who can read it. Now these reserves stand out like islands in the paddy plain, but when they were originally taken up to supply fuel to the newly made railway they were carved out of a forest tract so large and so dense that no villages thought it worth while to claim any rights in the areas now reserved. In less than sixty years that forest tract has disappeared and become paddy land the only reminders of the former forest being the tall *kanyin* trees standing here and there in the fields, too tall to overshadow the crops or too thick to be tackled by the villager.

The same thing has happened and is happening all over Burma.

Where the land could be used for permanent cultivation such destruction of the forest growth was quite right and proper, since food crops are the more valuable of the two, but what about the broken country? There the villager could not make paddy fields and he could have gone on getting his houseposts, his planking, his firewood, his ropes and his potherbs indefinitely, if he had stuck to that, but he went further. Other people wanted houses, so the villager saw a chance of making money and he felled more than he wanted for himself and traded it away. He also cut *taungyas* sometimes before he had sold the trees sometimes after. Even so the forest might have grown up again but in the intervals the villager allowed the regrowth to burn every year, he cut it over at short intervals to sell as firewood and charcoal and grazed his cattle there at the same time. That is the finishing touch which has given rise to the miles of worthless scrub which marks the last stage of the unclassed forest.

Timber will never grow there again under present conditions and it would take several human generations for it to come back even it were reserved now.

Hence we can say that the unclassed forests are a wasting asset to the country and that every ton of timber cut from them is gone for ever. It also means that every year from now onwards we have to find half a million or more tons of timber to supply our wants, of which 300,000 tons can never be replaced.

We have also to find over a million tons of firewood, but here the question is not so urgent because a certain amount of firewood does replace itself on the unclassed forest land until the last stage of degradation is reached. All the same those who have to deal with these matters know that every year the firewood suppliers of the big towns like Rangoon have to go further and further afield to get fuel, showing that the unclassed areas near at hand are virtually exhausted.

"YOUR WOOD WILL COST YOU MORE."

What then is the real meaning of these gloomy statements. A timber famine? No, certainly not. That phrase is a scare headline which has been so misused that it has done infinite harm to sensible forestry, but the real meaning is that "your wood will

cost you more," very much more, and that unless steps are taken in time, Burma might, with plenty of timber in her reserved forest, become a timber importing instead of exporting country.

There is no need for this to happen, "we have much goods laid up for many years" but unfortunately the stores are in inner chambers or on upper floors and Nature when she built this land which houses us, left out most of the doorways and nearly all the staircases. We can't get at our store rooms, our reserved forests are relatively inaccessible.

When our main reserves were being formed two factors influenced the choice of their situations, the presence of teak which does not concern the present argument, and the desire to put them well out of the villager's way.

There was so much forest all over the country that no one apart from the professional foresters could dream of anyone wanting reserves for anything but teak and everybody spoke cheerfully of "inexhaustible forest".

To bring teak to the market does not need wheeled traffic; the rivers and the side streams were and are both the easiest and the cheapest means of transport, so for the most part the reserves were confined to the higher parts of the hills and in any case to country where carts only get with difficulty. Without wheels, however, hardly a stick of any other timber can come out of the reserves. It is by the making of roads that we can go on meeting the annual demand for half a million tons of timber other than teak and the timber is there all right.

Most districts in Burma have the same physical features and it is on the low hills between the reserves and the paddy plain that we find the unclassed forests, in fact round about the point where the ordinary cart tracks come to an end. In some favoured spots the tracks lead or have been led in recent years into the reserves and wherever they do we find people bringing out timber. It is from such areas that the present 30 to 40 per cent. of the annual supply comes, showing that the accessible unclassed forests are getting exhausted.

There would be nothing to worry about if the accessible reserves only were capable of giving 100 per cent. of the demand,

but they cannot. All the reserves could with probably something to spare, on the basis of the present stock; but not those which are accessible just now, unless we were to repeat the mistakes of the past and cut ahead of what the area can yield continuously.

The Burmese timber cart is a wonderful contrivance for getting over bad country and it is astonishing how far it has managed to penetrate in the last ten years with the help of a bit of bridging here and easing off the gradient there, but even the Burmese cart cannot swim or fly. It is just a question whether the village cart can meet the future demand for forest transport, more especially when the leads get longer, but at present there is nothing to compete with it and what is to be done is to make the reserves accessible to the cart.

In many parts of the Pegu Yoma the first stage of accessibility can be reached by tackling a few of the difficult gorges or passes which now stop traffic. That combined with good permanent bridging will open up a big area of country but the work will be costly since it means attacking all the most difficult points first. This, however, is not enough. Village carts can find their way over very rough country but usually at the cost of very small loads. One important way of speeding up delivery and keeping down costs is to increase the load per trip which can only be done by providing a decently graded properly surfaced road.

SEASONAL NATURE OF LOCAL TIMBER TRADE.

Yet another point has to be considered. The biggest handicap to the local timber trade in Burma is its seasonal nature. Most of the carted timber comes out between January and May when the paddy carting is at its height. As time goes on with the longer leads from the more distant reserves either more carts and cattle will have to be brought into existence to keep up the same quantity of output or the carting season must be lengthened. The latter is by far the more desirable alternative for the producer, the manufacturer and the consumer, though to arrive at it permanent all-weather trunk roads must be made in the reserves and not only there but made and maintained in the strip of country between the reserves and the railway or river.

It is estimated that every mile of trunk road inside the reserves opens up two square miles of forest directly and from four to six additional square miles through the means of subsidiary cart tracks.

Taking a stock of six millable tons of timber per acre and twice that amount of firewood we find that under an eighty year rotation each mile of trunk road makes available 48×2 *plus* $48 \times 4 = 288$ tons of timber and 576 tons of fuel per annum on the basis of sustained yield.

Such a statement will be met with a snort of derision, and no doubt the figure is a formidable one more especially when one comes to reckon in the link roads between the reserves and the railways. Still there is no reason to snort, many intensively worked European forests have a length of metalled road corresponding to more than one mile per square mile of forest and are naturally much better supplied with roads outside the forest limits.

Anyhow, however ridiculous the proposition may sound at this moment it is not a question of prophecy but of fact that unless the reserves are opened up by good cart roads available during the whole or most of the year, Burma will not be able to supply all her requirements herself and will have to import timber.

Assuming the above gloomy fact, the hardest thing to get people to realise is that a very long-sighted programme of steadily sustained effort is needed. The road s must be there before the extraction of timber starts otherwise the trader will not risk his money or if he does he will lose it and much good material will be left to rot on the ground.

Road making in the forest is not like work in an open well inhabited part of the country. You cannot make up leeway by suddenly doubling your labour force, for there are usually very definite limits fixed by water and supplies to the amount of men you can keep at work and further it is rarely possible to work at more than one section of a road and that at the immediate road head.

Finance has been the great obstacle in the past to any comprehensive scheme of roads in the forests. Not that money has

been refused but that there has never been any certainty that the following year would afford the same provision or even any at all. Under such circumstances no labour could be organised nor staff set aside and practically no contractor would look at forest road work except at fantastic rates.

Yet without assured finance for a long period of years it seems impossible to draw up any scheme to meet the situation. So long as the progress has to depend on what the budgeters of the moment think can be spared for road work so long will the mileage finished lag behind the amount really necessary and unfortunately the ill effects of that lag will not show up immediately, they will only appear several years later when supplies of timber begin to run short.

A LOAN—THE IDEAL WAY OF FINANCING.

A loan seems to be the ideal way of financing such a programme for it would ease the budget of heavy charges particularly in the expensive stages at the beginning while the interest charges on the loan would amount to far less than the amount of forest capital which the country has taken out of its forests in the past forty years and spent as if it were merely interest. Actually the present need of spending large sums to stave off a timber shortage is only the natural punishment descending on the country for having failed to distinguish in the past between capital and interest. Nations cannot escape this retribution any more than individuals.

Besides the mere question of getting timber and fuel out of the reserves, the opening up of these areas means increased consumption of minor produce from the forests. Experience has shown that every well situated forest road has led to a heavy outgoing traffic in bamboos, thatching grass and the like and to a definite ingoing traffic of supplies to forest villages and camps. Such additional traffic naturally does not bring in much to the forest revenue but it bulks quite large in the comfort and prosperity of the neighbouring cultivators.

To conclude. The position put forward above is not a matter of prophecy but of calculation which anyone can check who

chooses to take the trouble. It is clear that the country cannot go on indefinitely cutting irreplaceably 300,000 tons of timber and 800,000 tons of firewood every year, no matter how big an area of reserved forest there may be in the background, if these reserves cannot be worked. Nor is it any use to expect that the remaining large areas of forest-covered public land still left in various parts of the province will stave off the day of reckoning for very long. Many of these areas are as economically unworkable as the inaccessible reserves and many really carry a much smaller stock than one would think at first sight.

The question is one which affects the Burman very vitally. Forests are a transferred subject so he cannot push the subject aside as being no concern of his, unless of course he prefers to buy eventually his wood from others in order to save himself the trouble of taking thought now.

(*Rangoon Gazette.*)

COOPERS HILL.

Sir John Denham described the view from Coopers Hill as embracing "a spatious and a fertile Greene," and Coopers Hill itself as "an airy mountain." Englefield Green was open land in the days of the poetical defender of Farnham Castle in the Parliamentary Wars, and from his house Denham must have seen in Coopers Hill a much greater apparent height than is now visible. "Neighbours on the Green," Mrs. Oliphant's book, recalls the fact that one of her friends at Englefield was the late Sir George Chesney, whose book "The Battle of Dorking" led to the formation of a ring of forts in the outer suburbs of London. Most of those forts have since been sold as building land by Messrs. Weatherall and Green (Chancery lane) on behalf of the Crown.

Now another property that was created by the Government has had its day, and the land and buildings provided, in 1870, for the training of Indian Civil servants in engineering have come into the market. The vendor is Elizabeth Lady Cheylesmore,

who has instructed Messrs. Lofts and Warner (Mount-street) to sell the estate. Institutional use is suggested for the premises and the obvious value of the land is for residential development, for which much of the 120 acres would be suitable. The wooded neighbourhood of Coopers Hill naturally reveals the results of the experiments of Dr. Schlich, who in 1885 established the Forest Section of Coopers Hill College.—(*The Times.*)

WILD LIFE IN IRAQ.

THE FINDING OF A CHEETAH.

Sir,—My subject is the occurrence of the cheetah or hunting leopard, *Cynælurus jubatus*, in Iraq.

In a pamphlet on Mesopotamian animals issued by the Bombay Natural History Society in 1916 a note states that "the cheetah may occur in Upper Mesopotamia, as it is still found in Asia Minor, Syria, and perhaps Palestine." In 1925 a cheetah cub was secured at Jumaimah, Muntafiq, Iraq. by a member of the Dahamshah tribe and brought in and presented to Mr. G. C. Kitching, of the Ministry of Interior. It is said to have been identified and placed on record by Sir Percy Cox. It was said to be about three weeks old, was fed on milk, and died after three weeks captivity.

In July, 1927, Nahaita, an Araif tribesman and professional desert hunter, reported to Captain C. E. Corry, Inspecting Officer of Police, Nasiriyah, that he had seen a leopard (*fahad*) in a "wadi" near Busiya. We visited the "wadi" and Captain Corry remarked that certain tracks were like those of a panther. We spent three hours in a vain effort to locate the animal. In July, 1928, the same hunter reported the same occurrence in the same "wadi." He was told to fetch in the skin, but returned, better still, with two cubs. He had followed tracks to an old well, thrown a stone down, and, after hearing a whimpering, the mother having flashed out and away, had climbed down and found the two youngters.

The cub in my possession is a female and probably about two months old. It is thriving, playful, and even affectionate. It

plays amicably with dogs. The fur on the back is fawn, quite long, being 2½in. to 3in., and unspotted. Belly and limbs are tawny and spotted black. The spots on the tail towards its extremity became rings. The legs are relatively long, and the claws are semi-retractile. The tail is more than half the length of the body. The ears are relatively large, roundish and black exteriorly; they are very mobile and are constantly being moved The head is broad, round, and high, the tear ducts being defined. It tumbles and springs about clumsily when free, eternally stalking playfully a small terrier upon whom it leaps from behind chairs, tops of tables, &c. It is very restless when tied up, and purrs intensively when I go to release it. It sleeps at night lying fully outstretched. As regards diet, milk, cooked liver, meat, and rice seem to suit it perfectly.

It was taken between Abu Ghar and Busiya, in the Shamiyah Desert, south-west of a sandbelt that teems with wild life. This region is about latitude 30 deg. 40 min. N., longitude 45deg. 45min. E., and altitude about 100 metres. Many old disused wells are scattered about, and I know of at least one perennial pool farther north. Gazelle abound, so do hare. The place Jumaimah, referred to above, may be considered in the same region. The "wadis" here are thickly covered in places with vegetation, even "nebuk" trees occurring.

Captain Corry very kindly gave this cub to me. Its fellow is also in Baghdad in the possession of an Iraqi Army officer. The local Arabs are as surprised as we. They have no special name for it, merely speaking as they do of a *fahad—i.e.*, leopard; even so their talk has a legendary ring, none of them having seen one before.

One wonders if after all the Babylonian lion is really extinct. There are still in Iraq many regions virgin to man's recording.

I am, &c.,

NORMAN L. CORKILL.

Department of Biology, Royal College of Medicine, Baghdad, Aug. 21.

(*The Times.*)

BRITISH ASSOCIATION—BRITISH FORESTS.

FORMER EXPERIMENTS IN SCOTLAND.

Sir John Stirling-Maxwell gave a lecture before the Botany Section, on "Scottish Forestry, Past, Present, and Future."

He said the disappearance of the pine forest from the Highlands remained to some extent a mystery. His own conclusions were that the forests on the higher parts were never of much account. There did not seem to have been much planting in the Highlands before the closing years of the 18th century, but in the Lowlands it began much earlier. But the bare aspect of the country evoked the caustic wit of Dr. Johnson and caused discomfiture to the faithful Boswell. It was difficult to realize how completely the Lowlands of Scotland were transformed from moor and bog to reclaimed and cultivated soil between 1700 and 1815. This was followed by extensive planting of trees, especially in Haddingtonshire and Aberdeenshire. The larch began to be planted in Scotland about the middle of the 18th century.

The second great introduction was the planting early in the 19th century of the conifers of the Pacific Coast. These had greatly increased the yield of the woods, although the timber was not so good as that of the common larch. A lull in planting seem to have occurred after Waterloo, probably due to the high price obtained for corn. The subsequent planting was not so carefully planned or so well executed. But the trees came in very useful during the Great War, though the finest timber naturally came from woods of the earlier period. The felling of timber during the War denuded the woodland area of Scotland by one-fifth, but at the close of the tenth year of the operations of the Forestry Commission 46,000 acres had actually been planted. Public bodies had planted 60,000 acres in the same time. The position was better than in 1919, but it was not yet satisfactory. One hundred thousand acres of the old woods were still derelict. The great argument in favour of afforestation in Scotland was that by it people could be permanently settled on the land in districts now almost uninhabited.

BALANCE OF AGRICULTURE AND FORESTRY.

The Forestry Department and the Agricultural Section held a joint session to discuss the economic balance of agriculture and forestry.

DR. J. D. SUTHERLAND, who opened, said forestry never took good arable land for planting, but was usually confined to rough grazings in hill districts and to the replanting of woodlands. Britain imported nearly £67,000,000 worth of wood and the products of wood every year. There was scope for an expansion of afforestation without serious encroachment upon the existing utilization of land in sheep farms. Afforestation gave employment to from five to ten times more men than stock-grazing, and therefore agriculture would benefit. He suggested that at least 10 per cent. of Britain might properly be laid down in tree crops without interfering with the supply of sheep for mutton and wool.

PROFESSOR R. G. WHITE (Bangor) doubted whether afforestation would continue to get cheap labour. He was in favour of replanting felled woodlands and waste land, but thought that when they proceeded farther they would be up against the sheep farmer. It must be remembered that the hill farmer to a great extent provided the raw material for the lowland farms in lambs to be fattened, &c.

FORESTRY IN WALES.

Mr. THOMSON (Bangor) read a paper in the Forestry Department dealing with the waste lands of North Wales, and said that the soils of the heath series appeared to be those on which the issue between forestry and grazing must be fought. The forester could not be expected to take the leavings of the sheep grazier. There was the possibility that the price of timber would rise, and that deterioration would take place in the more desirable hill grazings; and there were many grazings in North Wales which must decline in value both as pasturage and as potential woodland.

SIR ROBERT GREIG (chairman Scottish Board of Agriculture) said that this question all "boiled down" to a question of policy. If it was decided to embark upon a policy of afforestation, then

forestry must take the necessary land with the least possible dislocation of agriculture. If ten times as many people would be employed, then the benefit was obvious, and he was certain that improvements in grass lands and in stock raising would fully compensate for the abstraction of 10 per cent. of the grazing land for forestry.

SIR JOHN STIRLING-MAXWELL, of the Forestry Commission, who presided, outlined the policy of the Commission as being one to interfere as little as possible with good grazing land. If the price of mutton and wool went down he believed that many sheep farms would at once become available for afforestation. (*The Times.*)

HUNTING BY BIG GAME.

Sir,—An intimacy of many years with tigers and leopards in India justifies me in endorsing fully the conclusions of General Burton in regard to the poor scenting powers of these animals. I have many times sat within a few feet of tigers and leopards without their showing any signs of uneasiness, although the odour from their bodies was quite apparent to me. It is little short of pathetic to observe a tiger endeavouring to work out a trail with his nose within a few inches of the ground, a trail which a wild dog would follow at a gallop and deer scent from hundreds of feet.

On the other hand, the senses of sight and hearing are wonderfully acute. The very slightest sound or movement has an immediate response. Where, for instance, a dog will gaze around to detect the origin of any sound, the tiger or leopard will instantly locate it. If tigers and leopards added an acute sense of scent to those of sight and hearing, it would be impossible for any living creature to escape them.

I am, &c.,

June, 22nd, 1928. S. EARDLEY WILMOT.

(*The Times.*)

HOME-GROWN TIMBERS.

SCHEDULE OF USES PREPARED BY EXPERTS.

A schedule of "The Uses of Home-Grown Timbers," compiled by a committee consisting of representatives of the Land Agents' Society, the Federated Home-Grown Timber Merchants' Association, the Royal Institute of British Architects, and the Department of Scientific and Industrial Research (Forest Products Research Laboratory), has just been published under the authority of H.M. Stationary Office (price 1s. net). A preliminary inquiry by the committee into the uses of home-grown timber with respect to the building industry revealed these facts:—

(1) That the variety of choice, the certainty of supplies, and the ease in obtaining seasoned, selected material have led architects to specify foreign timber as a general rule. In doing so they are no doubt often unfamiliar with the possibilities of home-grown timbers. (2) That, apart from building operations, there are a great many outlets for home-grown timbers and that, were more precise information available as to their uses and physical and mechanical properties, the demand might be expected to increase. (3) That much can be done to increase the demand by offering home-grown timber to the user more carefully manufactured, graded, and seasoned.

The scope of the inquiry was afterwards enlarged to include all purposes for which home-grown timber might be used, and among the more important points revealed by the discussions of the committee were the following:—

That more scientific methods are necessary to grow straight clean timber free from knots than has been the case in the past that every endeavour should be made to produce greater quantities of timber in concentrated areas; that greater attention should be paid to the study of home-grown timber and the available home markets; that timber research should be extended as rapidly as possible and that results should be published as soon as available; that the question of adopting scientific and economic

methods of seasoning timber is of paramount importance; and that every endeavour should be made to reduce waste and loss in conversion, by more careful milling and by studying more fully the markets for small articles, produced from material resulting from off-cuts and short lengths.

The committee hope that the schedule may serve as a foundation to more complete and detailed knowledge of each individul species.—*(The Times.)*

DRY-ROT IN WOOD.

Prevention and Remedy.

A notable addition to the publications of the Department of Scientific and Industrial Research is a Bulletin prepared by the Director of Forest Products Research entitled "Dry-Rot in Wood" (Stationery Office, price 1s. 6d.).

The disastrous effects of the form of decay known as dry-rot are familiar, but the number of cases still arising in which disease has been invited by faulty building construction and improper use of timber, or where inadequate remedies are applied, proves the need for wide dissemination of the knowledge obtained by experts in their investigations of this serious problem. The Director points out that the purposes of the Bulletin, which has been written by specialists in different branches of the subject, are to present in a simple and practical form the sum of existing knowledge of dry-rot, to assist recognition of the signs of the disease, and to provide authoritative information of its prevention and remedy.

The salient points that emerge are: (1) that heat, air, and moisture are necessary for the growth of all dry-rot fungi; (2) that the fungi will not thrive when a great excess of one of these agencies is present; (3) that, although a fungus may be killed by excessive heat, it is probable that no extreme of natural cold will kill it, although its growth may be restricted; and (4) speaking very generally, softwoods are more frequently attacked than hardwoods, sapwood more frequently than heartwood, and quick-growing timber more frequently than slow-growing.

Professor Percy Groom, who contributes a chapter on the biology of fungi causing dry-rot in timber, shows that the fungi cannot attack and digest all kinds of wood with equal facility. In the first place, sapwood is more readily attacked and more perishable than the heartwood of the same timber, in those species which show a clear distinction in colour between sapwood and heartwood, as is the case with oak, red deal, and pitch pine. It is necessary to emphasize this statement, as it is sometimes alleged that the sapwood of the most important building timber in Europe red deal, is quite as durable as the heartwood, the well-preserved sapwood of this timber in old beams, joists, and rafters being pointed to in support of the contention. The fact is that the sapwood, so long as it is dry, resists decay, but when moistened it rots much more readily than the heartwood. Again, some kinds of fungi can set up dry-rot only in certain kinds of timbers, softwoods (*i.e.*, coniferous timbers), for instance; whereas other kinds, including *Merulius lacrymans*, can destroy timbers ranging from softwoods to such durable hardwoods as oak, teak, and mahogany.

Very important in facilitating the spread of dry-rot is the fact that the fungi responsible can live at the expense of organic materials other than wood. They can feed on paper, potatoes, jellies containing extracts of fruits or meats, and, above all, at least some of them can grow on moist garden soil. The result is that a house can become infected with *Merulius lacrymans* through the agency of the soil.

REMOVAL OF INFECTED TIMBER.

Various writers contribute to the chapter on detection and practical treatment of the disease. It is pointed out that during the process of removal of infected timber it is important to follow up all visible signs of the fungus, which may be found penetrating through the joints of brick walls and even between successive layers of plaster. It may extend for considerable distances, from one part of the building to another. Cases have, in fact, been known where the fungus has travelled from a ground floor between the layers of plaster up to the first floor and has there attacked

the timbers. It is a common experience to find the fungus spreading from floors to skirtings, door frames, and architraves. Another instance which may be quoted as somewhat unusual in character was where the fungus travelled (in the form of a string, or piece of cord) along the flange of a rolled steel joist for a distance of more than 10ft. It had its origin in timber near one end of the joist, and was eventually able to attack the timber at the other end, although there was no timber in contact with the steel on which the fungus could feed.

All decayed or unsound timber must be removed, including that which appears sound but is part of a decayed piece or is contiguous to a piece that is affected. This wood should not be left inside the building, but should immediately be removed to the open air and burnt. After all the decayed timber has been removed, a very careful examination should be made to determine whether there are any defect in the structure, or in the mode of construction, that are giving rise to conditions conducive to the development of dry-rot. Such conditions are that moisture is gaining access in some manner and that there is lack of free circulation of air around the timber.

Details are given of the various methods of sterilization and their comparative effects, the precautions needed in using preservatives, and the manner of application. A chapter is devoted to the precautions to be taken in the use of timber in new buildings in order to prevent outbreaks of dry-rot.—*(The Times.)*

FAUNA OF THE EMPIRE.

As the world has been opened up by the greater facilities for travel, as civilization has spread into formerly unoccupied areas, wild life has suffered not only by great diminution in numbers but by the actual extinction of races and species. The immediate causes vary. Sometimes it is mere disturbance, sometimes uncontrolled sport, sometimes ruthless exploitation, sometimes a just, sometimes an ignorant, fear that has procured or permitted extermination of beast and bird or reptile. The rate of destruction may be prodigious. Less than a century ago

the beautiful quagga covered the open plains of South *Africa.* The species is now wholly extinct. Less than a century ago the passenger pigeon existed in countless millions in the United States; the last surviving individual died in captivity a few year ago. Neither numbers nor beauty nor usefulness have sufficed to preserve wild animals, and the danger is greater to-day than ever before. An exterminated species is lost for all time, and the natural interest and wonder of the world are decreased. Can it be said with certainty that any beast or bird or reptile is so evil so harmful to man or to man's use of the earth, that its destruction is justified? Every one knows how often the mistaken destruction of birds has brought harm to famers by the resulting uncontrolled multiplication of insect enemies of crops. It is stated that a similar destruction of serpents in Madagascar is being followed by an immense increase in the numbers and the depredations of small rodents.

Because of its geographical range and climatic variety, the British Empire contains a large proportion of the surviving species of vertebrated terrestrial animals, and on it lies the duty of leading the way in protecting this living wealth for the pleasure and the profit of future generations. Lord Onslow and others commend to general notice the activities of a society whose object is the preservation of the fauna of our own Empire and by co-operation with similar societies in other countries, the fauna of the whole world. The names of the signatories are a guarantee that the objects of the society will be pursued with knowledge and discretion. The society has members and active supporters in India, in the British Dominions, and in the Protectorates, as well as in Great Britain and Ireland. It pursues its objects by the stimulation of interest and the collection of information. It is not opposed to legitimate sport and it recognizes fully that, where there is a real conflict between the preservation of man and of animals, man must clearly come first. It advocates adequate game laws with adequate observation of them the strict protection of species known to be on the verge of extinction, and above all the establishment in suitable areas of National Parks and Game Reserves which shall be absolute sanctuaries for wild animals of all kinds. Clearly local know

ledge and local needs must carry a preponderating weight in arranging the details, but much can be done by collecting information from all quarters and by stimulating and co-ordinating, the efforts at preservation in different regions. The annual subscription is only ten shillings, and it is to be hoped that the Society will receive an increase in its membership sufficient to enable it to pursue its objects with the energy they require.—(*The Times.*)